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Forest Fire Management in the Northwest Territories

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— a review of 1979 forest fire operations and forest fire management policy

“ . . . not of the letter but of the
spirit: for the letter killeth, but the
spirit giveth life.”

II Cor. 3:6



Prepared for the Minister of
Indian Affairs and Northern Development
Forest Fire Review Panel
April, 1980

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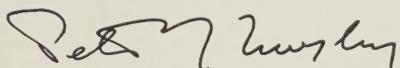
Hon. John C. Munro
Minister of Indian Affairs
and Northern Development
Parliament Buildings
Ottawa, Ontario
Dear Mr. Munro:

We are pleased to submit this report on Forest Fire Management in the Northwest Territories, a review of 1979 forest fire operations in the Fort Smith District and fire management policy in the Northwest Territories.

We believe that this report presents a fair representation of the 1979 fire situation, which was certainly a serious one. Recommendations give direction for improving the situation. Time was an ever-present constraint.

There are many fine people in the North. We are optimistic for its future.

Yours sincerely,



Peter J. Murphy
Chairman



Stanley R. Hughes



John S. Mactavish

Executive Summary

Introduction

In 1979 the Northwest Territories experienced the most severe wildfire season in 30 years of record. A total of 380 fires burned 1 989 130 hectares (4,915,240 ac.). The situation was most severe in the Fort Smith District where 179 fires burned 1 402 950 hectares (3,466,700 ac.), 70% of the total.

Fires burned unchecked in important trapping and caribou hunting areas east of Fort Smith. One major fire threatened the town of Pine Point for several days. Another fire destroyed 30 percent of the mature timber in the Slave River valley. Smoke from very large fires seriously obstructed visibility and for several days prevented scheduled commercial aircraft from using the Fort Smith airport. Fire control air operations were also seriously hampered because of smoke. It became difficult at times to detect new fires until they had become very large and impossible to suppress.

There was great and sincere concern expressed by the people of the North about the destruction of vast areas of forest on which many depended for trapping, hunting and a traditional way of life. The Forest Service of the Northern Affairs Program was strongly criticized for failure to provide adequate protection of the resource values at risk.

Fire Review Panel

In response to strong representations made by the Hunters and Trappers Association of Fort Smith and others, the Minister of Indian Affairs and Northern Development appointed an independent Fire Review Panel on November 1, 1979. The Panel was asked to review the fire control operations of the 1979 fire season in the vicinity of Fort Smith and to assess the efficiency of operations, adherence to fire policy, and the adequacy of information dissemination. For the Northwest Territories as a whole, the Panel was requested to review all aspects of fire management policy, criteria, objectives and fire action guidelines.

The Panel undertook a series of public meetings in Fort Smith and 17 other communities, extending to Inuvik in the north and Fort Liard in the southwest corner of the Northwest Territories. The views of all concerned were solicited at informal meetings. We also sought out and met with scientists and representatives of special interest groups in the North. In addition the Panel arranged for sub-studies to be undertaken on subjects of special concern including reviews of scientific evidence on the impact of fire on furbearer species and fish, and socio-economic implications of fire in the North.

The Panel was unable to assess fire damages adequately because winter had arrived in the North by the time the Panel was appointed, and because the Panel's recommendations were required before the 1980 fire season began. Furthermore, many of the fire effects, such as on furbearer harvests, will not become fully known for a number of years.

The Present Policy

The principal objective of the Federal Government's present fire management policy is "to reduce wildfire damages to a level consistent with the present and future needs of the people". There are four major elements to the policy; the fire management objectives for each zone; the action guidelines for each zone, and the manner in which these policies are actually implemented.

The policy defines four priority zones for forest fire management. The first priority is devoted to protection of human life and property. Priority Zone 1 includes those areas within 32 km (20 mi) of communities larger than 500 people, and within 16 km (10 mi) of settlements with 25-500 people.

The fire control objective for Zone 1 is to extinguish those fires that could threaten life and property associated directly with the communities.

Priority Zone 2 encompasses areas within 3.25 km of small communities, producing mines, tourist lodges, and narrow strips of land on either side of transmission and communication lines, and major highways. Accessible merchantable timber stands and young stands of trees on highly productive sites are also included.

Fire control objectives for Zone 2 are less specific than for Zone 1. The Department's manual states that: "Fires may (emphasis ours) be actioned if ample justification exists based on assessments of manpower and equipment availability, operational feasibility, anticipated short and long term effects of fire . . . and the alternative uses of limited suppression and suppression funds."

The majority of natural resource values are assigned to Zone 3, including high value habitat for wildlife, important trapping areas, and high quality but inaccessible timber sites. The fire management objective for Zone 3 is basically the same as that for Zone 2.

Zone 4 includes all other forested land and tundra in an unprotected zone.

The potential advantage of this policy is that it provides for a flexible approach to allow the Forest Service to control wildfires to the extent required for optimum resource management effectiveness. For the last several years, at least, an overriding objective has been to reduce perceived fire suppression "overexpenditures" in line with the Government's overall fiscal restraint program. In 1976 there was a shrinkage in total area protected in Zones 1, 2 and 3. Beginning in 1977 financial considerations led to the abandonment of Zone 3 as a protected area. As a consequence, much of the trapping and hunting areas important to those who pursue the traditional lifestyle of living off the land were left unprotected.

The people did not seem to understand the policy of the Forest Service. They did not understand how many of their main trapping areas were left unprotected when previous statements of Government had indicated to them that key trapping and hunting areas would receive protection. Government policy seemed to imply to native northerners that the option of living the traditional lifestyles on the land would be maintained as an alternative to entering the wage economy.

A strong positive force is the expressed wish of the people to be involved to a much greater extent — involved in planning and objective setting, and in firefighting activities so that they can benefit from the development opportunities therein.

Values-at-Risk

In the study area there are basically two types of communities, those where native northerners make up at least 85% of the population and those where natives account for fewer than 30%. In the first category the economies of the communities are heavily dependent on hunting of country food, primarily caribou and moose, together with fur trapping to provide the necessary cash income to maintain the traditional lifestyle. Few opportunities are available for wage employment in these communities. On a geographic basis these widely scattered communities dominate the region.

The second community category includes the wage economy towns where mineral or oil development or government administration offer employment opportunities. Populations are primarily from southern Canada. Even in these communities, however, there are significant native elements who cling to the traditional way of life.

The major values at risk to damage by fire in addition to communities and physical structures are caribou winter range, furbearer species habitat, and timber.

To the native people the land and its products are very important. This point was brought out with forceful sincerity in every com-

munity visited by the Panel. The major products of concern are meat, largely caribou, and furbearers. Where potentially merchantable timber resources existed, these too were identified as important. Since the native culture developed around life on the land and hunting activities in particular, there is great concern that there remain opportunities to allow individuals to choose that way of life and maintain cultural traditions.

Country Food and Furbearers

The rationale frequently put forward in the scientific literature, and sometimes by the Department of Indian Affairs and Northern Development, is that fire is a natural factor in the environment and that lightning-caused fires have created a mosaic of habitat types in which there is a variety of plant and animal species. From a long range ecological point of view, it has been suggested that nature be allowed to take its course.

The adoption of a "let burn" policy may have been appropriate when native northerners did not live in fixed communities, but migrated with the game they depended upon. Now that they live in fixed communities they suffer losses in terms of time, food and money if major fires occur within traditional hunting and trapping areas. The numbers of people in the Northwest Territories are substantially greater now, too, increasing the demands for all products from the land.

With respect to the caribou, there are two principle questions. The first is whether or not the overall amount of winter range available to them is a limiting factor to their survival. Evidence available suggests this is not the case, although it could become a factor should the decision be made to try to increase the size of caribou herds in response to rising demands for country food.

The second factor relates to the cost of hunting. If large fires in or near traditional hunting areas deflect caribou migrations away from Northwest Territories settlements, then the hunters would incur increased costs in locating the herds and retrieving their meat supplies. Scientists seem divided on this point. Those who live on the land, however, are convinced that large burned areas, such as those that occurred in 1979, do deflect migrations and may prevent the herds from reaching important unburned portions of the winter range.

Lichen (caribou moss) species make up a very significant part of caribou winter diet. Following fire it takes perhaps 50 years for desirable species to become re-established. Stand ages of between 75-150 years produce the most productive winter ranges for caribou. An average annual burning rate of approximately 1% then should be acceptable to maintain adequate winter range conditions.

The immediate impact of forest fires on harvests of furbearers is fairly easy to judge. Populations drop drastically or are eliminated. Recovery periods vary with the species involved, the size of the burned over area, and the intensity of the fire. In general, the limited scientific evidence available from other areas suggests that water-based species such as beaver, muskrat and mink populations should recover within 5-6 years of fire. Red fox and weasel require up to 10 years, but squirrels and marten seem to require semi-mature forests and may need 25 years or more to repopulate a burned area.

Lynx populations are intimately related to the highly cyclical populations of hare, their major prey species. The impact of fire on lynx may be difficult to separate from the impact of hare population fluctuations. It does appear, however, that lynx may need 20 years to re-establish on large burned over areas.

While these recovery rates are not long from an ecological point of view, they may be disastrously long from the point of view of individual trappers.

With respect to both furbearers and country food the major question is one of determining how much fire is acceptable consider-

ing the demands on the resources by the people, the management plans of natural resource agencies, the impact of fires and the costs of fire control. Until such time as more precise scientific direction becomes available the Panel believes that an average annual rate of burn of up to 1% would be acceptable as long as large contiguous areas are not burned over within short spans of years. This should yield a mosaic of vegetation conditions and varied wildlife habitats suitable to most species, and should minimize the serious dislocations caused by the occurrence of very large fires. Large areas with average annual rates of burn of 2% and 3% were identified.

Timber

There are limited areas of productive forest land in the Northwest Territories, largely confined to the valleys of the Slave, Liard and Mackenzie rivers. Mature timber stocks in various locations offer an important resource base for present and future economic development of local communities.

The Panel found that when stands of timber are destroyed, the damages estimated by the Department of Indian Affairs and Northern Development were based on the minimal administratively set price for standing timber, a price set low to encourage the harvesting and use of the timber. The Panel does not believe that this is an accurate reflection of real losses. Since there are very few areas of productive forest lands in the first instance, and since it takes 150 years or more to produce sawlog size timber, we suggest that for all practical purposes those stands of timber represent "perishable non-renewable resources". These resources represent development opportunities, and their loss by fire amounts to development opportunities foregone. Damage estimates should include the present worth of all the potential value-added through harvesting and milling that would also be lost.

Fire Management Operations in the Fort Smith District — 1979

Efficiency of Operations

The Panel believes that many of the criticisms leveled at the Forest Service resulted from concern and frustration of the public seeing large fires burning out of control in Priority Zones 2, 3 and 4 with no significant suppression action being taken by the Forest Service. The apparent shortcomings of the Forest Service were related to the unpopular fire management policy, limited permanent staff and suppression budget constraints. Within its constraints the Forest Service performed a reasonable task in a very difficult year.

Efficiency in the Fort Smith District was reduced by a weak fire detection system, and shortages of fire control supervisors, trained firefighters, air transportation and by fatigue.

The Panel has made a number of recommendations to solve these problems. Only those that appear most urgent are summarized here.

To fulfill the requirements of a credible fire management operation, supplementary funds are required in 1980 for improved staffing and training, and necessary development projects to maintain adequate protection in the present Zones 1 and 2, and to initiate some initial attack capability in Zone 3. In particular, two man-years are required in 1980 to provide for a fire behaviour specialist and an aircraft dispatcher.

To remove the known deficiencies in the fire detection system one new fire lookout is required in the Pine Point area and existing fire lookouts in the Fort Smith District should be manned in 1980.

One aircraft used for fire detection patrols should be equipped with an infrared scanner to permit detection when visibility is reduced by smoke.

Training and certification programs for firefighters and supervisors need major expansion with emphasis placed on employment of native people.

Adherence to Policy

The Panel did not find evidence to indicate that the Fort Smith District staff failed to follow the Department's fire management policy except with respect to fire control in Zone 3. The problem is primarily with the policy itself and the public's understanding of it. The policy provides for changes in protection levels in Priority Zones 2, 3, and 4 depending on fire loads in higher priority areas, availability of men and equipment and the rationing of limited funds. In 1979, all three factors came into play. There were serious fires and a high risk of others in Zone 1. There was a large number of fires burning at one time in Zones 1 and 2. The Forest Service assessment of budgetary constraints prompted the removal of Zone 3 from protected status in 1977. The Panel is concerned that this decision appears to be in conflict with the Department's official policy.

The financial constraints placed on the Forest Service contributed to its inability to meet the Department's objective. The basis for policy development and implementation should be based primarily on natural resource management objectives rather than financial management objectives as discussed elsewhere in this summary.

Dissemination of Information

The Panel heard testimony and studied statistics, fire reports, maps and files of the Forest Service offices in Fort Smith. There were gaps in information, errors in records and sometimes conflicting statistics, but all were of a minor nature. There was no evidence of any attempt to deliberately mislead the public or the Minister. Greater efforts should have been made, however, to reach the public and keep them informed of the fire situation. They lacked successful communication with the Fort Smith Hunters and Trappers Association and many native groups.

There was a deep misunderstanding of the word "disaster" applied to the large areas of burn east of Fort Smith. For the hunters and trappers affected the situation was a disaster. Further, for those not affected directly it had disastrous implications by demonstrating what would happen in other areas without a fundamental policy change. The Forest Service did not consider it to be a disaster because of their interpretation of the fire management policy.

The credibility of the Forest Service suffered seriously in 1979. Forest Service staff in the Fort Smith District must visit every community before and during the 1980 fire season to advise the public of their plans, to listen to concerns, and to respond to concerns.

Improved communication with all elements of the public must be made an important objective of the Forest Service staff.

Recommended Policy Guidelines

The Panel's review of fire management policies in the Northwest Territories together with a specific review of fire operations in the Fort Smith District has yielded a proposed set of fire management objectives, together with some 90 policy guideline recommendations designed to meet these objectives.

The major objectives for wildfire management must be:

- a. To protect human life and property.
- b. To protect natural resources to the degree that meets the

requirements of natural resource management agencies and reflects to the interests of the people.

It is essential that the agencies responsible for managing resources determine their own objectives and, in particular, their needs with respect to fire control. Their requirements supported by socio-economic justification must be supplied to the Forest Service if it, in turn, is to develop an appropriate fire management plan and obtain the funds to carry it out.

Public Involvement

The Panel encountered high levels of frustration among native northerners who felt that their interests in the protection of natural resources from fire were either misunderstood or ignored by the Forest Service. More effective consultation is required on both formal and informal bases.

A Forestry Advisory Board for the Northwest Territories should be established to provide a means of providing advice on objectives and priorities of fire management. Membership on the Board should include representatives of the Forest Service, the GNWT Wildlife Service, Hunters and Trappers Association, Dene Nation, Metis Association, NWT Grade Stamping Association and others with particular interests in the land.

Local advisory groups should be set up at the community level to discuss and advise on district matters.

Fire Management Zones

The present four priority zones governing wildfire management should be scrapped and replaced with two — a Fire Attack Zone and an Observation Zone.

Within the Fire Attack Zone, the Forest Service must have the capability for prompt detection, initial attack and control of fires before fire intensity begins to build on the second day of a fire.

Fires that escape initial attack control should receive sustained attack until controlled when any communities or major properties are threatened, or when potentially merchantable timber stands in the Slave River and Liard Timber Management Units are threatened. In all other areas fires that escape initial attack should be assessed in light of circumstances and strategy options to determine what, if any, additional action should be taken.

Delineation of all the areas containing resource values deserving initial attack protection, and an implementation schedule will be an exacting task. It should be done in close consultation with the local advisory groups. Initial attack capability should be extended to: identified key trapping areas; lands with high potential for timber growth, watershed values, or erosion risks; and critical areas of caribou winter range.

The Forest Service should be prepared to provide defensive fire control action to isolated homes, lodges and camps. Defensive action could include the loaning of firefighting equipment for self-help attack on nearby fires, burning out in front of advancing fires, advice on fuel reduction programs to reduce risks around habitations and evacuations if required.

The Panel has identified three areas where recent fire history has caused an excessive rate of burns, and where initial attack capability should be extended at least on an interim basis until the average annual rate of burning becomes less than 1%. Beginning in 1980 a start must be made to extend initial attack into approximately 24 000 km² east of the Talton River south of Great Slaved Lake, an area of some 40 000 km² north and west of Yellowknife, and the central portion of the Horn Plateau area.

The Observation Zone should include those areas where little use is being made of the land or where the average annual rate of burning has been within acceptable limits of less than 1%. In this

Zone fires would be observed and action taken only if higher value areas appeared in danger and opportunities occurred to stop or divert the advance of the fire by burning out from natural fire breaks around the fire.

Fire Detection

Rapid fire detection is essential to the success of an initial attack fire suppression policy. It is urgently important for the Forest Service to develop a comprehensive fire detection plan to include a combination of fixed lookouts, aerial patrols, and directional lightning detectors.

In 1980 high priority must be given to development of an emergency detection plan to provide for the use of temporary lookout facilities and increased aerial patrols with at least one aircraft fitted with an infrared scanner to allow fires to be detected when visibility is reduced by smoke.

Manpower Requirements

It is impossible to state full staffing requirements until the Forest Service develops an approved fire management plan based on the Panel's recommendations. However, the Panel has identified some serious deficiencies that should be overcome in 1980. Some have already been indicated in the review of operations in the Fort Smith District.

Immediate new requirements include three five-man seasonal suppression crews supported by helicopter or float plane transportation and fixed wing aerial detection patrols. The crews should be stationed in the Fort Smith area, Yellowknife and Fort Simpson. Their primary task would be to begin an initial attack capability on the three special areas identified by the Panel, other key trapping areas to be identified in consultation with community advisory groups, and to add necessary support to the existing organization in protecting communities and areas supporting merchantable timber.

Planning

Planning for years of extreme fire conditions that exceed normal resources is essential. The Forest Service must have the flexibility and financial support to act in anticipation of severe fire loads. A trained pool of firefighters must be developed in each District. Mutual support agreements with neighbouring jurisdictions should be updated. More flexible accounting procedures should be adopted to allow movement of men and equipment into strategic areas in anticipation of fire outbreaks.

Conclusion

This executive summary highlights the major findings and recommendations of the Panel's report on fire management policies and operations in the Northwest Territories. The Forest Services' capability is in an early development stage. The 1979 fire season was particularly hazardous and would have been a difficult challenge even to a more mature and better equipped organization. If the traditional life-style option is to be maintained for native Northerners the planned and scheduled development of a better equipped, more effective fire management agency involving native people is important. The cost-effectiveness of a strong initial attack capability is recommended as the most attractive option for most areas where resource values require protection.

Overriding all is the essential need for a fire management plan based on the needs of the people and involving them in its preparation, budget support to implement the plan, and giving staff increased freedom for judgement and action within the plan guidelines.

Acknowledgements

As stated in the contract, time was of the essence in this review. We would like to extend thanks to those who helped to expedite the process — staff of the Northern Affairs Program for preparing data, charts, maps and reports, and our many sub-contractors who rushed to complete their studies on time.

Arrangements for public meetings, travel meals and accommodation were capably handled by Margaret Johnston. Her patience and adaptability in response to continually altered itineraries is very much appreciated. Public information and technical assistance was provided by Claire Martin who also enlivened our travels.

Over 100 individuals responded willingly to our requests for submissions and consultations with patience and cooperation. These people are listed in the Appendix — we thank them very much for their help.

We are particularly indebted to the staff of the Department of Forest Science at The University of Alberta for their willingness to assist in the extra work which this study entailed, and especially to Deirdre Cartledge and Linda Ehrler for their forbearance and unflagging support.

A special word of appreciation is extended to the many hunters and trappers of the Northwest Territories and their families who took valuable time away from their traditional income-making activities to meet with us and to express their views.

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Part I

**Introduction and
Northwest Territories Background**

Chapter 1 Introduction

1.1 Mandate

The 1979 fire season in the Northwest Territories resulted in the greatest area burned in 30 years of recorded history. The problem was particularly severe in the Fort Smith District which experienced a record number of 179 fires, about half of the total, and almost 75% of the area of burn.

These fires caused alarm among a number of northern people and brought to a head longer-standing concerns over the Federal Government's fire management policy and level of fire control. This was particularly the case in the Fort Smith area where a number of people representing the Hunters and Trappers Association, local Indian Band and others formed a delegation to visit the Hon. Jake Epp, Minister of Indian Affairs and Northern Development in Ottawa. As a result of these representations the Minister promised to set up a Fire Review Panel at the end of the fire season to investigate the situation.

Forest fire control is relatively new to the Northwest Territories. It is still very much in a developmental stage with very little capital resource base. Demands for fire suppression during the early 1960's resulted in a formal policy in 1967. A serious year in 1971 caused reconsideration which resulted in both policy and financing changes. The serious year in 1979 and expressed alarm suggested it was again time for a review.

The three-member Fire Review Panel was established November 1, 1979 with a two-part mandate as follows:

"Part A will involve examining the forest fire situation in the Northwest Territories and assessing the efficiency of operations, adherence to fire management policy and dissemination of information in the Fort Smith District of the Northern Affairs Program.

Part B will be concerned with reviewing all aspects of the fire management policy, criteria, objectives and fire action guidelines in the Northwest Territories for the purpose of recommending modification or continuation of the present policy."

The full terms of reference are included in the Appendix.

1.2 The Land

The Northwest Territories contains a vast forested area of 1 366 194 km² (527,490 sq. mi.) within the limits of the treeline. The topography, landforms and ground cover vary from the western mountains through the Mackenzie Valley region and the Canadian Shield to the east. The population of the Northwest Territories approximates 46 000 of which about 29 000 live within the forested area in some 24 communities of varied sizes.

The renewable resources include a number of wildlife species of which the single most important is probably the barren ground caribou. In the southwest moose becomes the major meat producer while throughout the land furbearers are an important cash crop. Timber resources and forest growth potential exists along the major waterways. The relationship between the native people and the land is strongly rooted in cultural tradition. A variety of recreational resources is also present. The development of roads, industries and communities throughout the region add an additional set of values at risk from forest fire.

Vegetative types are virtually all flammable with varying characteristics. The fuels in combination with weather factors, particularly long hours of summer daylight with accompanying high temperatures, lend themselves to fires of rapid spread, high intensity and large size. Fires occur on the tundra, but are not common and apparently soon recover (Wein 1975). This report deals only with the land south of the treeline.

The land is characterized by great distances, variation throughout, substantial land-based activity among the people, and a sparse population located in scattered centres.

These conditions had a profound effect on the approach taken by the Fire Review Panel.

1.3 Fire Review Panel Activities

Panel members assembled immediately during the first week in November. A trip was made to Fort Smith during the second week and part of the burned areas were flown over in company with J. Schaeffer, President of the Hunters and Trappers Association of Fort Smith. A brief visit was also paid to senior fire management staff of the Forest Service.¹

Panel members realized that time would be the major constraint in this review, given the complexity of the problem and the vastness of the land. Several studies were sub-contracted to try to provide necessary background information. A list of these is included in the Appendix. Letters and information about the Review were mailed to 178 individuals, groups and agencies inviting comments and participation. In addition, newspaper advertisements were placed in all papers in the region along with selected journals in the neighbouring areas of Yukon, British Columbia, Alberta and Saskatchewan. Advertising was handled by the Northern Affairs staff in Yellowknife who also arranged radio coverage and issued news releases. A total of 35 written submissions was received. These are listed in the Appendix.

Interest among residents of the Northwest Territories is reflected in the requests from communities to have the Panel visit. Meetings were held in a total of 18 communities, with return visits to two of them. In the process, Panel members logged about 8 300 km in charter aircraft, plus substantial travel by other means. A list of the communities visited is included in the Appendix.

In addition to the community meetings, Panel members individually and collectively held interviews and consultations with over 110 people including hunters and trappers, Government representatives, representatives of organizations and agencies, and scientists. A list of those consulted is in the Appendix.

The first and longest public meeting was held in Fort Smith mid-December with sessions dealing both with a review of concerns as expressed by local people, and a review of Forest Service operations. A copy of the Fort Smith agenda is included in the Appendix to show the nature of the problems raised. In total the Panel spent five weeks in the Northwest Territories, and individual members returned for several specific visits at other times.

1.4 The Report

The public concerns fell largely into one of two major categories — effectiveness of the fire control operations, and perceived deficiencies in the policy itself. This report is presented in three major parts. The first presents background material related to the people, land and resources necessary to see the problems in perspective. The second part deals with the effectiveness, adherence to policy, and information dissemination related to the 1979 fire season in the Fort

Smith District, as called for in Part A of our mandate. Part III deals with the broader issues of policy. Fort Smith experiences are used as examples of problems in the Northwest Territories and the need for policy changes. This last section is designed to satisfy the objectives outlined in Part B of the mandate.

Recommendations in Part II relate primarily to improving operational aspects within the present policy framework. Recommendations in Part III deal with changes to the basic policy, as well as to a wide-ranging number of related aspects all designed to effect overall improvements.

Chapter 2 The Northwest Territories — Land and Environment

2.1 The Northwest Territories

The Northwest Territories is a large and diverse land, a fact with important implications in both land management and fire management planning. The area within the limits of the treeline is approximately 1 366 000 km² (527,500 sq. mi.), an area twice the size of Alberta, and almost 20 times that of New Brunswick. Within this large area lies a great diversity in physiographic regions, landforms, soils, climate and vegetation. With very sparse populations and long distances, problems of transportation, manpower, supplies and communications may all become critical. The area under consideration is illustrated in Figure 2.1. It ranges from latitude 60 — 70 degrees N, and from longitude 95 — 137 degrees W.

There are three major physiographic regions. West of the Mackenzie River is the Cordilleran region, the northern extension of the Rocky Mountains. The major ranges are the Mackenzie mountains in the west and south, Richardson mountains in the northwest, and the Franklin mountains immediately east of the Mackenzie River. This area of primarily sedimentary rocks includes mountain ranges, deep valleys, high plateaus with glacial till, and low altitude plains.

To the east of the Mackenzie lies the Interior Plains region, extending to the Slave River, the north arm of Great Slave Lake, the east side of Great Bear Lake, and northward to the portion of the Arctic coast near Paulatuk. In this area Precambrian rock is overlain by limestone, shale, and sandstone that gradually increase in depth from east to west.

The portion of perhaps greatest economic interest, the Mackenzie Lowlands includes extensive muskeg interspersed with low, rugged mountain ranges and localized delta formations.

Further east, and extending to the coast of Hudson Bay lies the Canadian Shield. The Shield is mostly Precambrian rock — granite, quartzite and others — frequently covered with only a shallow layer of glacial till. Topography is often rugged and ranges from sea level to over 760 m (2,500 ft.) in elevation. There is an extremely extensive network of streams, lakes, and small water bodies of various shapes and sizes (Rowe, 1972).

Soil profile development is rudimentary or absent in the northernmost sections and becomes progressively more advanced away from the tundra — although peat development can occur anywhere. The natural decomposition of litter by bacteria and fungi is extremely slow. In the northernmost section of the Boreal Forest, soil development is further inhibited by the proximity of permafrost near the surface. Most of the Boreal Forest has a mixture of rock and frozen organic and sporadically frozen brunisolic and gleysolic soils, with some regular occurrence of podzols, chernozems and regosols in the Cordilleran region (Rowe, 1972). Deeper alluvial soils along some of the major waterways can support commercial forest growth.

The climate within the forested area of the Northwest Territories is relatively uniform (Rowe, 1972). The summers tend to be moderately warm, sunny and dry, and the winters long and cold. Mean annual precipitation ranges between 25 and 360 mm (10-14 inches) — only slightly above values typical of true deserts. Of this precipitation, a little less than half falls as snow. Mean annual total snowfall is remarkably uniform, varying in depth between 102 and 127 cm (40-50 in.). Rainfall during May-September is only 150-200 mm (6-8 inches). Many lakes and ponds are present — despite limited precipitation — because the brief summers do not permit massive evaporation and because permafrost, which is widespread in the Northwest Territories, greatly inhibits drainage.

Mean annual temperatures in the Mackenzie Valley are a fairly uniform -8 to -4°C (17 to 25°F). Daily average minimum temperatures in January range from -30 to -35°C (-24 to -32°F). Average July maximum temperature is in the 20-23°C range (68-74°F). Maximum summer temperatures vary only slightly above or below 30°C (86°F) regardless of whether the location is far north of the Arctic Circle in the Mackenzie Delta or at Yellowknife on Great Slave

Lake. High temperatures and low relative humidities greatly influence fuel drying, ease of ignition and fire intensity.

The growing season is short. In the Northwest Territories the length varies from approximately 80 days in the Mackenzie Delta to between 120 and 140 days in areas approaching latitude 60°. The long hours of daylight during June and July, however, have a great influence on growth in fire size.

The treed area of the Northwest Territories falls entirely within the Boreal Forest Region described by Rowe (1972). Within this region lie parts of seven Forest Sections, as illustrated in Figure 2.2 (Rowe 1972).

The Boreal Forest of the Northwest Territories consists primarily of open stands of slow-growing black and white spruce (*Picea mariana* and *P. glauca*) and a ground cover of lichens and/or mosses which becomes quite dense as the stands age. This forest is interspersed with many treeless bogs that are often fringed by larch (*Larix laricina*) and by occasional dense and tall forest stands. In the southern portion of the Northwest Territories jack pine (*Pinus banksiana*) is common on sandy soils and some uplands. The common deciduous trees, often prominent following fire, include trembling

aspen (*Populus tremuloides*), balsam poplar (*P. balsamifera*) and white birch (*Betula papyrifera*). To the west of the Mackenzie River, lodgepole pine (*Pinus contorta*) and Alaska birch (*Betula neoalaskana*) are locally prominent.

In the north there is an increasing trend toward domination by black spruce and bogs. The bogs range in composition from rich grass (*Gramineae*) and sedge (*Carex* spp.) through more numerous sphagnum (*Sphagnum* spp.) mosses. Particularly common are tussock sedge areas with sphagnum moss and many low ericaceous shrubs. Among the more common plants are dwarf birch (*Betula glandulosa*) and Labrador Tea (*Ledum groenlandicum*), both common to bog and upland sites (Rowe 1972). As noted later, these plants are all flammable at times. Several species of willows (*Salix* spp.) occasionally cover large expanses along rivers, around bogs and marshes. These are important for moose.

The Forest Sections described by Rowe (1972) reflect the great variability within the Northwest Territories. Forest and plant associations in each have an affect on fire behaviour. They also have a bearing on wildlife, and on the related cultural values. Some of the major features of each are noted. Descriptions are based on Rowe (1972).

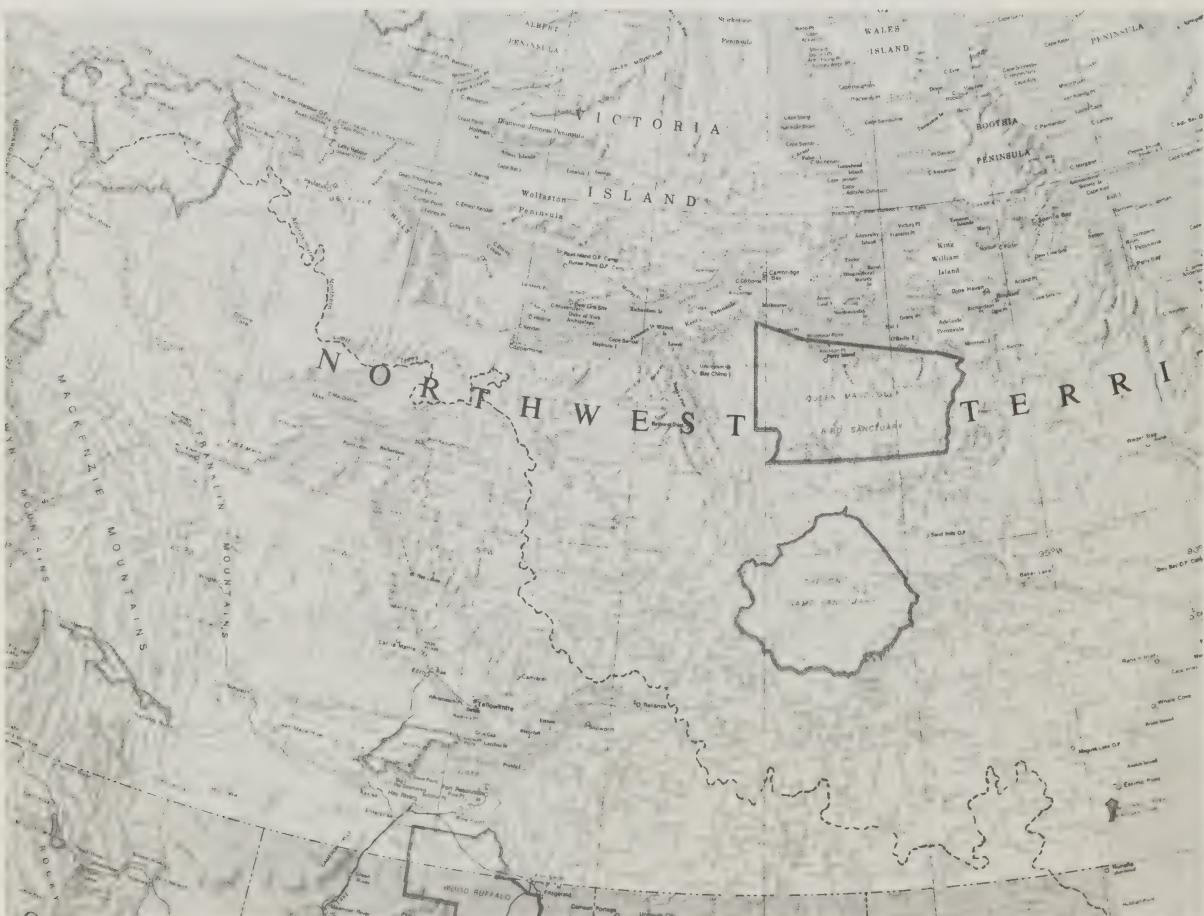


Figure 2.1: Map showing the forested area of the Northwest Territories.

B.18 b — Hay River

Since this is an extension of the Mixedwood Forest post-fire recovery in mixedwood stands will often favour moose. Some of the sites have superior timber-growing capabilities. The black spruce associations lend themselves to large-fire spread through the continuity of fuels. A few better-drained sites support growth of commercial timber.

B.23 a — Upper Mackenzie

This area includes some of the best timber-producing land along the major waterways. White spruce and balsam poplar form the main cover types on the alluvial flats bordering the rivers.

The presence of large saw-timber size trees on the riverine sites indicates that these areas as yet have not been particularly fire-prone. The major threat is larger fires moving into these sites from outside. The areas of particular interest to the forest products industry are in this section. The presence of trembling aspen on the upland sites suggests post-fire recovery potential for moose. The decreasing abundance of poplar species towards the north was

reflected in part at the meetings through less frequent reference to moose in the more northerly areas.

B.23 b — Lower Mackenzie

Some saw-log size timber has been noted in surveys in this area, especially on some of the well-drained backlands. The presence of willow, particularly along watercourses lends itself to maintaining local moose populations. The highland areas of black spruce on permafrost are quite flammable. The presence of non-treed lands such as bog areas suggest possibilities for control of large fires by indirect attack using aerial support, taking advantage of the sparse fuels and natural breaks.

B.24 — Upper Liard

Good forest growth is found here, particularly on soils of the alluvial flats. Presence of saw-timber size white spruce on alluvial flats suggests sites which are not inherently fire-prone, but vulnerable to fires moving in from upland areas. The presence of lodgepole pine on upland sites indicates possibilities for forest industries based on smaller-wood requirements. It also indicates a history of previous



Figure 2.2: Sections of the Boreal Forest in the Northwest Territories. Rowe 1972

fires. The poplar species common should favour moose.

B.27 — Northwestern transition

This largest of the sections leading to the tundra edge shows substantial variation within it reflecting differences in soils and climate. In general, the continuity of vegetation and the flammable nature of the lichen ground cover, shrubs, black spruce throughout and jack pine in the south lend themselves to development of large fires. The presence of numerous lakes and watercourses suggests possibilities for water bombing, and indirect attack on fires using natural barriers. These areas are important barren ground caribou winter ranges. Some woodland caribou range in the southwest. The presence of aspen, and willows along watercourses provides some local moose habitat. The entire area is much used for hunting, trapping and fishing. Forest growth is good on some sheltered deep-soil sites, but access will likely preclude commercial use for some time.

B.32 — Forest-tundra

The surface fuels of lichens and shrubs provide continuity for fire development, although fuel densities are lower and fires are generally less intense. The section forms part of the barren ground caribou range, and also supports a few moose, particularly along watercourses supporting heavy stands of willow. Trapping activity is also extended into this section.

B.33 — Alpine forest-tundra

Open park-like stands of stunted white spruce, alternating with patches of grassy or shrubby vegetation, or with rocky barrens, are a characteristic of the mountain slopes up to treeline at about 1050-1150 m(3500-3800 ft). Aerial observation indicates that this section also experiences extensive fires. However, relatively little human activity apparently takes place within it except at higher elevations which sustain big game guiding and outfitting in the early fall. The effect of fire on the major big game species is not clear, but does not appear to be unfavourable.

2.2 The People

The population of the Northwest Territories is estimated as 46 398 as of the end of December, 1978 (Drury, 1980). Of this number, 28 530 live in communities within the forested area (Manecon 1980). This population is distributed among about 30 communities of varying sizes ranging from a score or so to 9,981 in Yellowknife. The figures in Table 2.1 indicate that 63% of the population as a whole consists of people of other than native ancestry. However, when the populations of Yellowknife, Fort Smith, Hay River, Inuvik, and Pine Point are subtracted, the remaining communities are 83% native people.

This point assumes significance since in most of the smaller communities in which native populations form a majority, the economy and lifestyle relate very closely to the land and the renewable resources derived from it.

In addition to the sparse population, distances between communities are great. The average airline distance between the 8 major communities on the Mackenzie River between Fort Providence and Inuvik is 170 km (105 mi.), with a range of 65-275 km (40-170 mi.) except for the highway between Fort Providence and Fort Simpson, most travel is by air, boat, or snow vehicle. These distances have an important bearing on travel times to initial attack, recruiting backup support, and obtaining firefighting supplies in quantity as needed.

The diversity of natural surroundings within the Northwest Territories was made earlier. An interesting recognition of this is seen in many of the traditional Dene tribal and band names which were in essence descriptions of the environment in which the people lived.

From these descriptions could be deduced in large measure the way of life and cultural traditions of the people involved. For example *Thebacha Dene* or people (of the water) against the rock — Chipeyan living in the Fort Smith area and east of the Slave River; *E'Le-dun Ottine* or No birch people — Slave living east of the mountains east of Wrigley; *T'Akkweh Ottine* or open water people — Dogrib living north of Great Slave Lake; *Kha-T'A Gottine* or people among the willows — Hare Skin living west of the Mackenzie northwest of Fort Good Hope, *Kwetchia Kutchin* or Delta people — Kuchin living around Arctic Red River. (Lamothe 1980). It is important to recognize this inherent diversity when dealing with the people, and developing approaches to management.

Table 2.1: Major Forested Area Communities of the Northwest Territories
Listed in Decreasing Order of Concentration of Natives in the Population - 1978

Community	Total Population	Native Population	% Native
Lac la Martre	225	222	99
Colville Lake	73	71	98
Trout Lake	60	58	97
Wrigley	175	166	95
For Liard	327	311	95
Arctic Red River	111	105	95
Jean Marie River	48	45	94
Fort Franklin	512	481	94
Fort Good Hope	446	415	93
Snowdrift/Reliance	271	253	93
Fort McPherson	812	747	92
Fort Norman	329	299	91
Rae-Edzo	1 269	1 155	91
Aklavik	761	677	89
Fort Providence	556	489	88
Fort Resolution	521	453	87
Nahanni Butte	94	79	84
Fort Simpson	1 080	637	59
Inuvik	2 938	852	29
Fort Smith	2 347	657	28
Hay River	3 398	781	23
Pine Point	3 398	334	19
Norman Wells	352	63	18
Yellowknife	9 981	1 298	13
Enterprise	40	0	0
TOTAL	28 486	10 648	47

Source: Manecon 1980 (G.N.W.T. Statistical Profile)

2.3 Forest Fires and Their Characteristics in the Northwest Territories

2.3.1 Introduction

Although the principles of fire behaviour apply globally, every area has distinctive characteristics of fuels, weather and climate, and to-

raphy which in turn give fires distinctive characteristics. Because of these differences no two fires are alike.

In the Northwest Territories lightning generated primarily through airmass and frontal activity ensures chances for ignition. Presence of flammable fuels provide opportunities for fires to start. Periods of summertime drought, high temperature, low relative humidity and long daylight hours provide conditions within which fires can burn with rapid rates of spread, high fire intensity and opportunity to reach large sizes.

Fire is not a recent occurrence in this region. Alexander MacKenzie noted a forest fire on August 14, 1789, apparently along both sides of the Liard River (Johnson & Rowe, 1974). Preliminary analysis of lake sediments near Norman Wells indicate recurrent fires for about the past 2 800 years (Rowe *et al.* 1975).

2.3.2 Fuels

Virtually all vegetation types are flammable at some time during the fire season. In general, poplars, willows, grass and sedge are especially flammable in spring before green-up or in fall after dead foliage has cured. Conifers are especially flammable during summer, and are suspected to be particularly so in late spring as a result of an apparent dip in green foliar moisture content (Stashko and McQueen 1973, Fuglem 1979).

Lichens are particularly flammable. They have no vascular tissue and lend themselves to rapid drying. They may become flammable within hours after a light rain. Many of the dwarf shrubs have resinous evergreen leaves and twigs. Even the deciduous birches and green alder are resinous and burn readily early in the year. Some surface fires may burn shrubs and conifer litter but not the lichens (Rowe *et al.* 1975). Higher relative humidity can result in reduced flammability of lichens while the resinous content of the other species can sustain fire.

Stands of aspen are generally less fire-prone in summer, and may be used to advantage as fuel breaks. However, open areas of grass and sedge may contain sufficient dead material within the green stems to carry fire, even during the summer.

Fires burning on the surface are relatively easy to fight. However, when fires burn into the crowns of standing trees the height of flame activity, fire intensity, and rate of spread all increase substantially. Fire is encouraged to reach into the crowns by the presence of "ladder" fuels which provide a vertical continuity of fuels. Black

spruce commonly retains branches to the ground so easily "torches" through a combination of dead twigs and flammable foliage. Both black spruce and jack pine have bark scales and fire will commonly travel into the crowns through them at times of low relative humidity. Arboreal lichens (old man's beard) are common in older stands and is also highly flammable in low humidities. As a result of these factors the development of crown fires is common when surface fires are intense enough to trigger them.

The ability of fire to grow in size is dependent on continuity of fuel. Except in some areas where lakes and rivers are common continuity of fuels in the Northwest Territories is such that large fires may readily develop. In fires of high intensity, "spotting" occurs and glowing or burning embers are carried ahead of the fire and across fuelbreaks. Helicopter support for observation and "bucketing" of water is essential.

Fuel characteristics will differ on upland and lowland sites. Upland sites are generally more fire-prone since they dry more quickly and thoroughly. However, in times of deep drought (high Buildup Index) virtually all sites become flammable.

Fuel volume has a tendency to build up with increasing stand age since the rate of biological decomposition in the North is less than the rates of growth. Also associated with age are development of flammable lichen and resinous shrubs. Rowe *et al.* (1974) wonder, for example, if the very large areas burned over in recent years in the northern part of the Mackenzie Valley may reflect the maturing of vegetation last burned in the 1800's.

2.3.3 Fire Numbers and Causes

The major fire cause in this region is lightning which accounts for about 63% of the fires and close to 97% of the areas burned. Virtually all lightning-caused fires occur during the three months of June, July, and August as shown in this Table for the years 1975-79.

Month	Lightning Fires (%)
May	1
June	34
July	48
August	16
September	1

The fire season itself extends essentially from May to September, as shown in Table 2.2. Again, most of the major activity occurs

Table 2.2: Summary of Forest Fires in the Northwest Territories
1975-1979 inclusive

	March	April	May	June	July	August	Sept.	Oct.	Total
Total Number of Fires ¹	2	8	77	466	582	281	51	9	1476
Percent of total	0	1	5	32	39	19	3	1	100
No. Man-caused Fires	2	8	66	145	139	129	42	9	540
No. Lightning-caused Fires	0	0	11	321	443	152	9	0	936
Percentage Lightning	0	0	14	69	76	54	18	0	63
Total Area Burned (ha) ² *	2	10	891	1 335 836	1 816 735	317 165	20 221	2	3 490 862
Percent of total	0	0	0	38	52	9	1	0	100
Area Man-caused Fires (ha)	2	20	877	37 495	7 246	69 990	434	2	116 056
Area Lightning-caused Fires (ha)	0	0	14	1 298 341	1 809 489	247 175	19 787	0	3 374 806
Percent Lightning	0	0	2	97	100	78	98	0	97

¹ Totals for the 5-year period

² Totals for the 5-year period

* indicates only month in which fire started

during the three summer months, of which July is normally the peak.

Development of lightning requires a lifting mechanism in addition to suitable air mass characteristics of instability and moisture. The three major lifting forces are orographic where air masses are lifted over hills and mountains, movements of fronts, and convective heating. In their studies of fires in the upper Mackenzie Valley, Rowe *et al.* (1975) concluded that convective instability due to surface heating within air masses was the major cause of thunderstorms. They identified two major areas of lightning incidence which they related to typical atmospheric circulation patterns. One of these lies along the western edge of the Shield north of Yellowknife along the Camsell River, the other in the Caribou Range area northeast of Fort Smith. In this last region they identified a seasonal "pulse" of lightning fires advancing northeasterly to treeline in July and retreating in August. These zones compare reasonably closely to the zones of fire occurrence identified by Simard (1975)(Figure 2.3).

Generation of thunderstorms due to relief may be responsible for the greater lightning activity in such areas as the Horn Plateau and other locations along the Mackenzie River east of the mountains. More study of lightning patterns and use of lightning detection equipment can greatly enhance earlier detection of fires.

Records of fire occurrence and areas burned by year show considerable variation as indicated in Table 2.3. There is an apparent increase in fire activity in the last decade compared to the previous two. Some of this is due to increased detection and more complete records, some may be a result of increased activity in the forest. There may be other basic causative factors such as climate or fuel changes, but that is speculative only.

Severe fire years throughout the entire Mackenzie Valley in any one year are infrequent. The environment that produces and nourishes forest fires seems to be regional rather than general over the Valley. Comparing fire histories around Fort Simpson and Norman Wells, Rowe *et al.* (1974) found only 2 years in which both areas experienced many fires. The other high-frequency fire years were distinctive to each area. A tentative hypothesis was that in one year out of four there would be a significant fire activity in the upper Mackenzie Valley from Fort Simpson to Norman Wells.

This pattern of occurrence suggests that for cost-effective control there has to be a base-level of attack capability able to handle most years, with ability to mobilize back-up resources quickly in anticipation of times of greater severity. The capability must include the recruitment of qualified manpower, aerial transport and funding. It

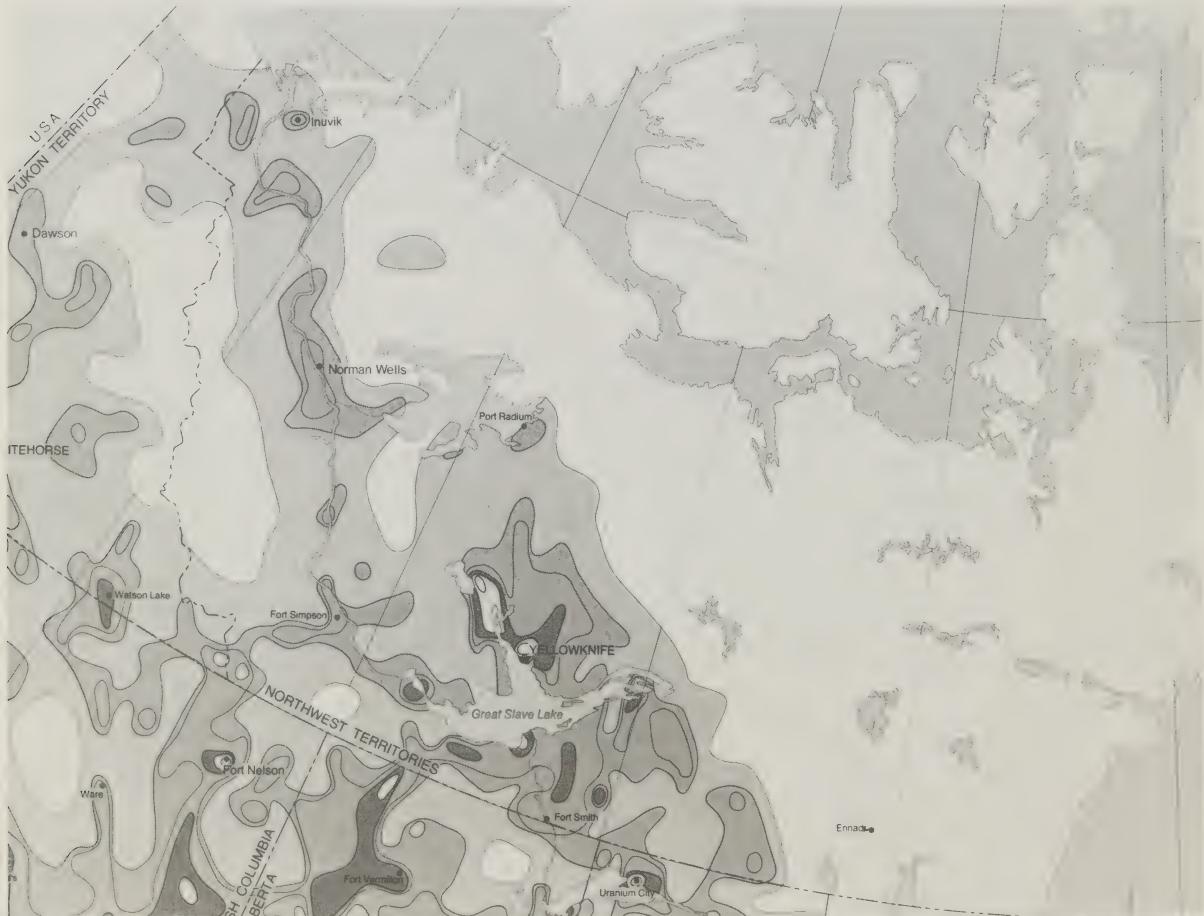


Figure 2.3: Zones of forest fire occurrence. Simard 1975

also suggests the need to be able to shift resources within the Northwest Territories in response to local needs.

In 1979 the fire load fell primarily in the Fort Smith District which had 179 fires, or 47% of the 380 fires in the Northwest Territories. Man-caused fires average 37% indicating possibilities for more effective preventative activities. In 1979 man-caused fires amounted to 23%, but since they are commonly located near settlements, they pose a threat and tie up resources. Recreation and industry are the two major causes, as shown in Table 2.4.

**Table 2.3: Northwest Territories
Number of Fires and Area Burned
Over Past 30 years**

YEAR	FIRE	ACRES	HECTARES
1950	88	737,600	298 490
1951	67	202,200	81 810
1952	36	185,200	74 930
1953	44	239,200	96 800
1954	95	663,512	268 520
1955	81	393,309	159 170
1956	56	640,483	259 200
1957	42	336,254	136 080
1958	71	86,064	34 830
1959	92	111,096	44 960
1960	104	102,077	41 310
1961	194	758,600	306 990
1962	88	24,500	9 920
1963	66	16,200	6 560
1964	146	457,357	185 090
1965	107	5,700	2 310
1966	240	518,400	209 790
1967	132	166,100	67 230
1968	119	567,500	229 640
1969	183	1,216,900	492 480
1970	179	513,400	207 760
1971	329	2,048,500	829 040
1972	327	556,400	225 180
1973	492	2,116,600	856 580
1974	183	91,700	37 140
1975	295	536,600	217 140
1976	302	642,480	260 010
1977	309	299,180	121 074
1978	156	195,283	79 030
1979	380	4,915,148	1 989 133

subjective estimates, further work on the FWI relation to northern conditions is warranted.

FWI Class	Flame Height
Low	Intermittent
Moderate	2 - 3 feet (0.6 - 1.0 m)
High	3 - 6 feet (1.0 - 2.0 m)
Very High	6 - 20 feet (2.0 - 6.0 m)
Extreme	to 120 feet + (35.0 m +)

The flame height in the high category was described as the limit at which direct attack with hand tools is possible because of radiant heat. During 1979 the FWI Index remained in the High or greater categories, except for only three short periods during the critical months of July and August.

Rates of spread at times of high FWI point out how critical it is to obtain early detection and launch rapid, hard-hitting initial attack if fires starting during those conditions are to be controlled.

Fire size is related to rate of spread, fuel continuity, days left in the burning season, and effectiveness of fire attack. In their 1975 study, Rowe *et al.* found that less than 10% of all fires were larger than 4 000 ha (10,000 ac.) but they accounted for about 80% of the total area burned. Fires in this larger size category were found to occur in years of many fire outbreaks, while in years of few fires the sizes were small. This further reinforces the point that where a target level of fire control is desired, it is important to be able to mobilize resources in response to predictors of heavy fire loads.

Some fires can grow quite large. In 1973 two fires of approximately 100 000 ha (250,000 ac.) each burned west of Fort Providence (Mills Lake fire) and east of Colville Lake. The total area of the large fire east of Fort Smith in 1979 was about 837 000 ha (2 million ac.) on both sides of latitude 60. In 1950 a fire burning for five months in the Chinchaga River region of Alberta also covered a similar area (Murphy 1978). The Mills Lake fire escaped initial attack and was abandoned after it blew up. The other three fires were not fought.

There are some important implications to large fires. They could lead to regional aridity through lowered relative humidity which could affect water yields and delta area and wildlife habitats (Rouse and Mills 1976). Aridity could also slow rates of vegetative recovery, and could lead to lower fuel moistures in surrounding areas.

Large fire areas may also deflect caribou migrations, effectively blocking access to other winter ranges (Scotter 1980). Rates of reproduction by furbearers and other small mammals may also be slower because of larger travel distances (Bunnell 1980) and slower rates of vegetative recovery.

2.3.4 Rates of Spread and Fire Size

Conditions in this region are conducive to rapid rates of fire spread. Lanoville (1979) described a spring fire near Wrigley which spread from 2 ha (5 ac.) at time of discovery to 1 000 ha (2,500 ac.) in two hours, and after only eight days of drying from the time of snowmelt. The Willowlake River fire in 1979 spread 11 km (7 mi.) in a 4.5 hour run, and travelled 19 km (12 mi.) the next day. The 1979 Pine Point fire ran 8 km (5 mi.) during its first major burning period.

The Forest Fire Weather Index developed by the Canadian Forestry Service (1976) provides a method for calculating relative fire severity based on weather factors. The numerical indices obtained are commonly categorized into descriptive classes. Lanoville described these categories in terms of typical flame height. These are

2.3.5 Fire Intensity

Fire intensity along with fire frequency are two aspects that have important implications for soils, vegetation structure, animal habitat and water relations, as described by Bradley *et al.* (1978) for this region. They point out that intensity is difficult to "tie down" in an ecologically meaningful way because its importance lies not in energy release as such but rather in how the energy release affects the ecosystem. Much depends on time of year, and on preceding and current weather conditions. For example, an intense fire in the spring may have little effect on soils because they are still frozen, while a fire of the same intensity in late summer may remove all organic surface material and initiate erosion. This is important when considering the role of the fire and possible ecological consequences of it.

Fire intensity also has a bearing on the percentage of vegetative cover actually consumed by fire. Bradley *et al.* (1978) point out that unburned inclusions within the fire perimeter may commonly amount

to 50%. Rowe *et al.* (1974) refer to a fire on the Horn Plateau which "covered" 51,200 acres but which included unburned areas mapped at 22,320 acres, or indicating a 66% burn. Kourtz (1980), using satellite imagery, estimated burns of 85% completeness on the Caribou range in 1979. The Inter figures fire for SM2 indicate 76% burn. The unburned areas may consist of patches missed where "stringers" or islands of timber were left because of topography, changes in fuel moisture, discontinuity of fuel or vagaries of wind.

These unburned residuals are important foci from which plants and animals can reinvade the surrounding burned area (Rowe *et al.* 1974). However, what is not certain is how important or useful these are in maintaining populations of furbearers or providing forage for caribou by virtue of their size, distribution, and accessibility within the burn. These are important questions for which answers are needed before an effective, rational program of fire management may be developed.

A second fire burning over the same area within a short period will have more profound results than one fire alone. A reburn can seriously retard vegetative recovery by depleting the energy reserves of resprouting plants, removing conifer regeneration for which no additional seed source is immediately available, or resulting in additional humus soil loss which may be particularly serious on thin soils over rock. The time for reburned sites to recover thus becomes much longer. If land is to be managed to maintain productivity, it suggests that recent burns in the recovery stage should be identified as needing a higher level of protection. Fires in these areas are not usually difficult to control since there is not as yet a heavy accumulation of fuel except for fallen snags.

and physical resistance to stopping the fire itself through clearing fuel breaks or applying water. In general, fuels in the region do not have a high resistance to control except during periods of high to extreme fire hazard. Lanoville (1979) describes spread rates in lichen fuels as extremely explosive and capable of rapid spread. However, since the fuels are light it does not take much effort to stop the fire. On the other hand, fires burning in heavier fuels will generate sufficient heat during high hazard times that direct attack becomes impossible.

A typical behaviour pattern in semi-open black spruce stands is the "line of fire" which is a combination surface fire in woody shrubs, moss and lichens with simultaneous "torching" of individual trees. This gives the appearance of a line or wall of crowning fire behaviour. Direct attack can only take place when fire spread slows so that "torching" is sporadic. This contrasts to the higher-intensity "crown" fire where fire travels within the crown canopy. These, too, defy direct attack.

A fuel combination difficult to control is mix of flashy fuels such as lichen, and deep organic fuels. The lichen itself is easily controlled, but fires may hold-over in the deep organic fuels in a smouldering condition during evenings or showy conditions only to reignite the flashy fuels again when they dry out. Fire may burn deeply into the organic fuels giving them a high resistance to control and consuming great time and effort to extinguish. This can result in long mop-up times on larger fires.

Treatment of fuels to reduce fire intensity and resistance to control around local high-value areas such as lodge or cabin sites or communities can reduce fire hazard.

2.3.6 Resistance to Control

The term resistance to control describes the difficulty of stopping a fire. Resistance is commonly seen as a combination of fire intensity

Table 2.4: Northwest Territories - 1979
Fires and Area Burned by General Cause and Priority Zone

GENERAL CAUSE	Fought					Not Fought					NUMBER OF FIRES	AREA (hectares)	AREA (acres)
	P.Z. 1	P.Z. 2	P.Z. 3	P.Z. 4	P.Z. 1	P.Z. 2	P.Z. 3	P.Z. 4					
Recreation	30 (89)	10 (7)	---	---	2 (7)	3 (2)	3 (5)	5 (5)	53	115	284		
Settlement	11 (5)	---	---	---	---	---	---	---	11	5	12		
Railway	---	---	---	---	---	---	---	---	---	---	---		
Woods Ops.	---	---	---	---	---	---	---	---	---	---	---		
Other Industry	7 (1,624)	---	---	4 (1,625)	---	2 (-)	---	1 (50)	14	3 299	8 152		
Misc. Known	9 (10)	---	---	---	---	1 (-)	---	---	10	10	25		
Unknown	---	---	---	---	---	---	---	---	292				
Lightning	30 (26,506)	81 (131,625)	15 (57,520)	1 (7,168)	2 (-)	4 (3,134)	29 (898,847)	130 (860,904)	1 985 704	4,906,675			
Total Fires	87	91	15	5	4	10	32	136	292				
Area Hectares	28 234	131 632	57 520	8 793	7	3 136	898 852	860 959	1 989 133				
Area Acres	69,766	325,263	142,132	21,728	17	7,749	2,221,063	2,127,430					

NOTE: numbers in bracket = area in hectares

Part II

**A Review of Fire Operations
in the Fort Smith District**

Chapter 3 Background

3.1 Introduction

The Panel was given two tasks, one to assess fire operations in the Fort Smith area, the other a review of fire management policy in the Northwest Territories. This portion of the report reviews events that occurred during the fire season in the Fort Smith District. It also considers fire control effectiveness and problems related to policy and public communication. Material in this Part II contains information examples, and implications which lead sequentially to fire policy determinations discussed in Part III.

The Panel based its assessment of the fire season in three major ways. We reviewed statistics and records, studied the daily chronology of major events, and evaluated four selected fires. These are summarized in the following chapters. An evaluation and recommendations follow.

In 1979 during the months of June, July and August 179 forest fires burned 1 402 950 ha (3,466,700 ac.) of forest land in the Fort Smith District. The number of fires and the area burned were the greatest in the history of the District and the impact on the environment and the people was severe. There was a great and sincere concern expressed by the people of the North about the destruction of vast areas of forest on which many depended on for trapping, hunting and a traditional way of life. The Forest Service was strongly criticized for its failure to provide adequate protection of the resource values at risk.

3.2 Fire Management in the Northwest Territories

3.2.1 Organization

Forest protection in the Northwest Territories is a responsibility of the Forest Service (Northern Affairs Program) of the Canada Department of Indian and Northern Affairs. The region is divided into four administrative districts Inuvik, Fort Simpson, Yellowknife and Fort Smith as shown in Figure 3.1. Each district is responsible for fire management. A regional staff at Fort Smith is responsible for coordination of all district fire activities. The regional fire staff does not have direct line authority over district fire control activities, but does provide technical and professional advice, and coordinates inter-district communication and movement of firefighting resources within the Northwest Territories.

As shown in the organization chart (Figure 3.2), the Regional Manager of Forest Resources reports to an Assistant Regional Director, while District Managers report to the Regional Director.

There are only seven year-round fire management personnel directly involved in operational aspects of fire management. The regional organization has three annual positions that provide support to fire management, and the four districts have one each. The Resource Management Officers and their assistants are directly responsible to a District Manager. During the fire season, if required their time may be fully allotted to fire control activities.

There are 131 seasonal positions available for approximately three months each year for employment of fire suppression crews and similar fire positions. When additional emergency firefighters are needed, they may be hired but costs must be charged to active fires. The allotment of manpower to the fire program was 54.5 man years in 1979.

The Fort Smith District in size of protection area is second only to the Inuvik District. The District organization is shown in Figure 3.3.

A Forest Protection Officer is responsible for the planning and coordination of fire activities within the three sub-districts which comprise the Fort Smith District. He does not have direct line authority over the Resource Management Officers and Assistant Re-

source Management Officers who are charged with the responsibility of fire management on a part time basis. The Panel has the view that the Forest Protection Officer must have responsibility and authority over the Sub-District Resource Management Officers on fire business. He must be able to give direction when and where required during the fire season to ensure that fire control policies and priorities are being followed.

The three Resource Management Officers and their four assistants are also responsible for land and water use programs which require attention during the fire season. Although fire suppression is accorded top work priority there are concerns over other workloads that must be postponed.

There are 42 seasonal fire positions available under the supervision of the Resource Management Officers. The seasonal positions provide six 5-man fire suppression crews, including six fire crew foremen, and miscellaneous fire-oriented positions.

3.2.2 Fire Management Policy

The current fire management policy in the Northwest Territories is based on a system of four Priority Zones, shown in Figure 3.1.

Priority Zone 1 has the highest fire action priority. It is concerned with the protection of human life and property directly associated with communities of over 25 persons.

Priority Zone 2 includes communities with less than 25 persons, lodges, mines, cabins, highways, power and communication lines, accessible merchantable timber stands and highly productive young forest growth sites.

Priority Zone 3 has for criteria the protection of high-value wildlife habitats, subsistence traplines, unique recreational areas, areas with high erosion potential, potential domestic watersheds, and high quality timber sites.

Priority Zone 4 is essentially a non-protection area and receives suppression action only if life, property or Zones 1 and 2 are immediately threatened.

Aggressive initial attack and follow up action is the rule in Priority Zones 1 and 2 only. There are many implied and direct financial restraints on fire action in each of the fire priority zones.

One major problem with the priority zone fire policy is that the protected area is effectively reduced as the severity of the fire season increases. In 1979 Zone 1 received adequate protection, Zone 2 was partially protected while Zones 3 and 4 were virtually unprotected areas. The priority zone policy is discussed in Chapter 11.

3.2.3 Protection Area

The area in the Northwest Territories listed as a protected area is 224 069 km² (86,520 sq. mi.), normally comprising fire Priority

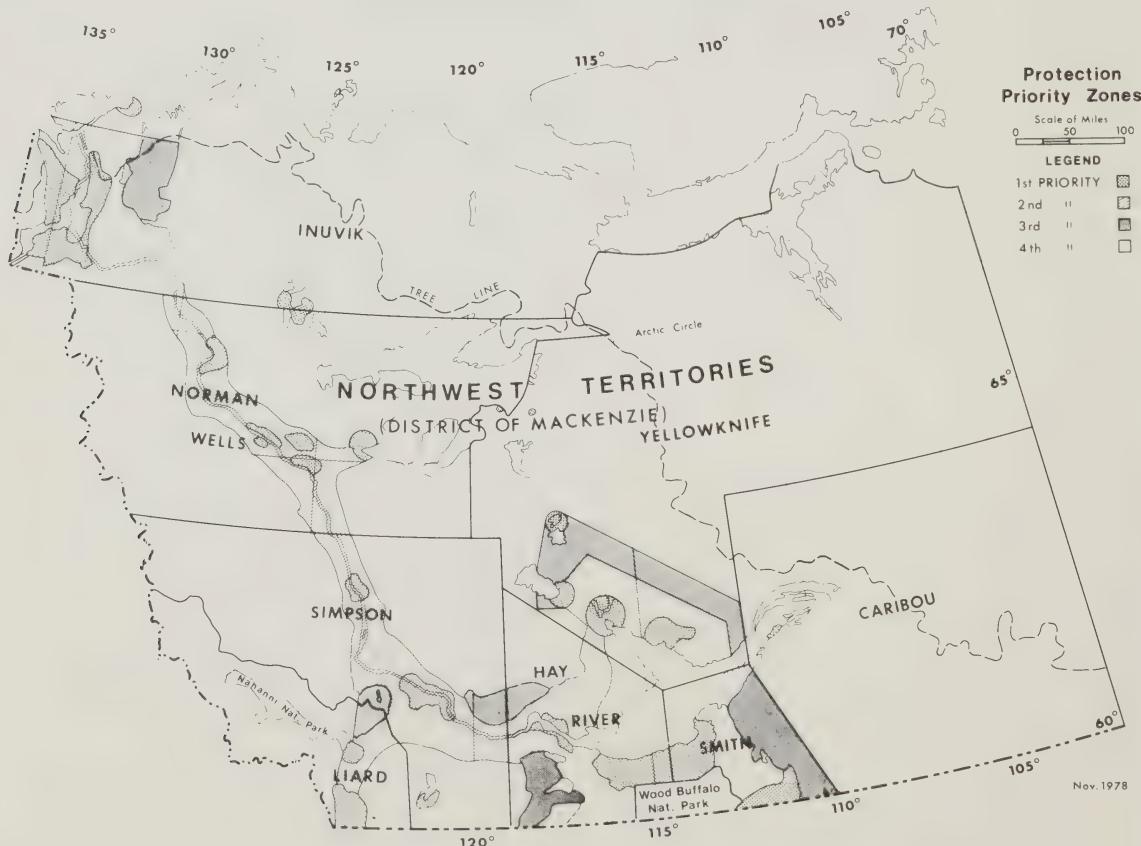


Figure 3.1: Districts and Protection Priority Zones in 1979.

Organization Chart Northwest Territories Northern Affairs Program

Full Time Operational Fire Staff

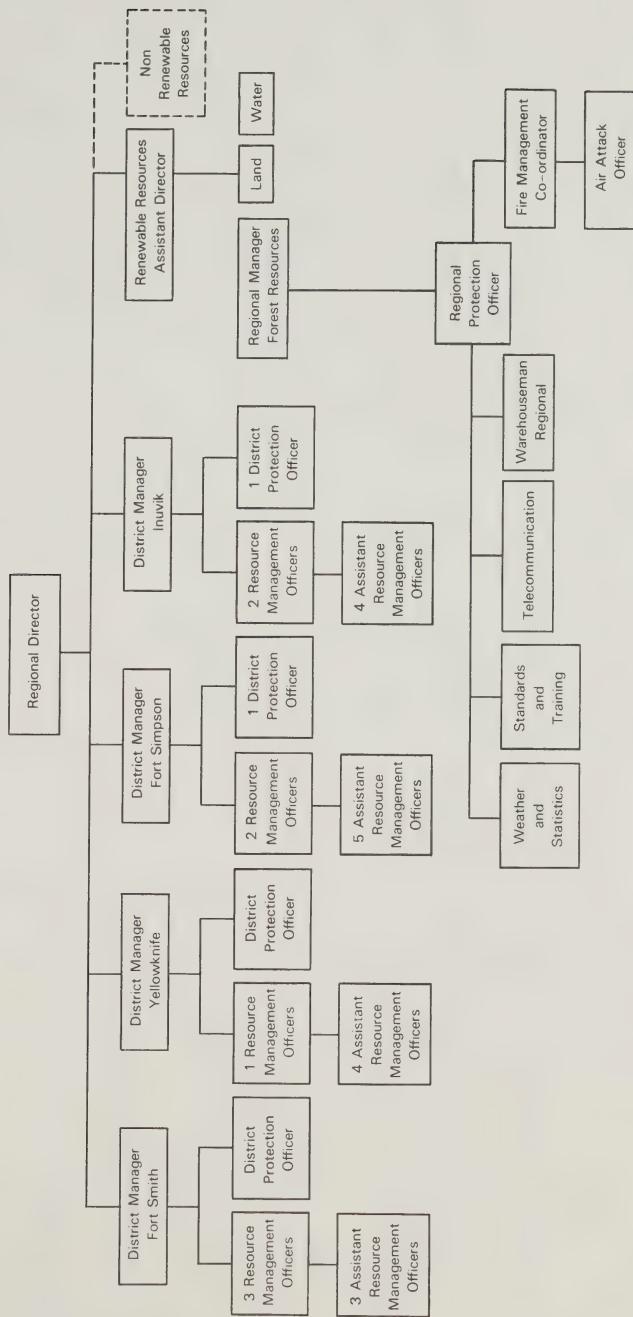


Figure 3.2: Organization Chart, Northwest Territories Northern Affairs Program

Organization Chart Fort Smith District

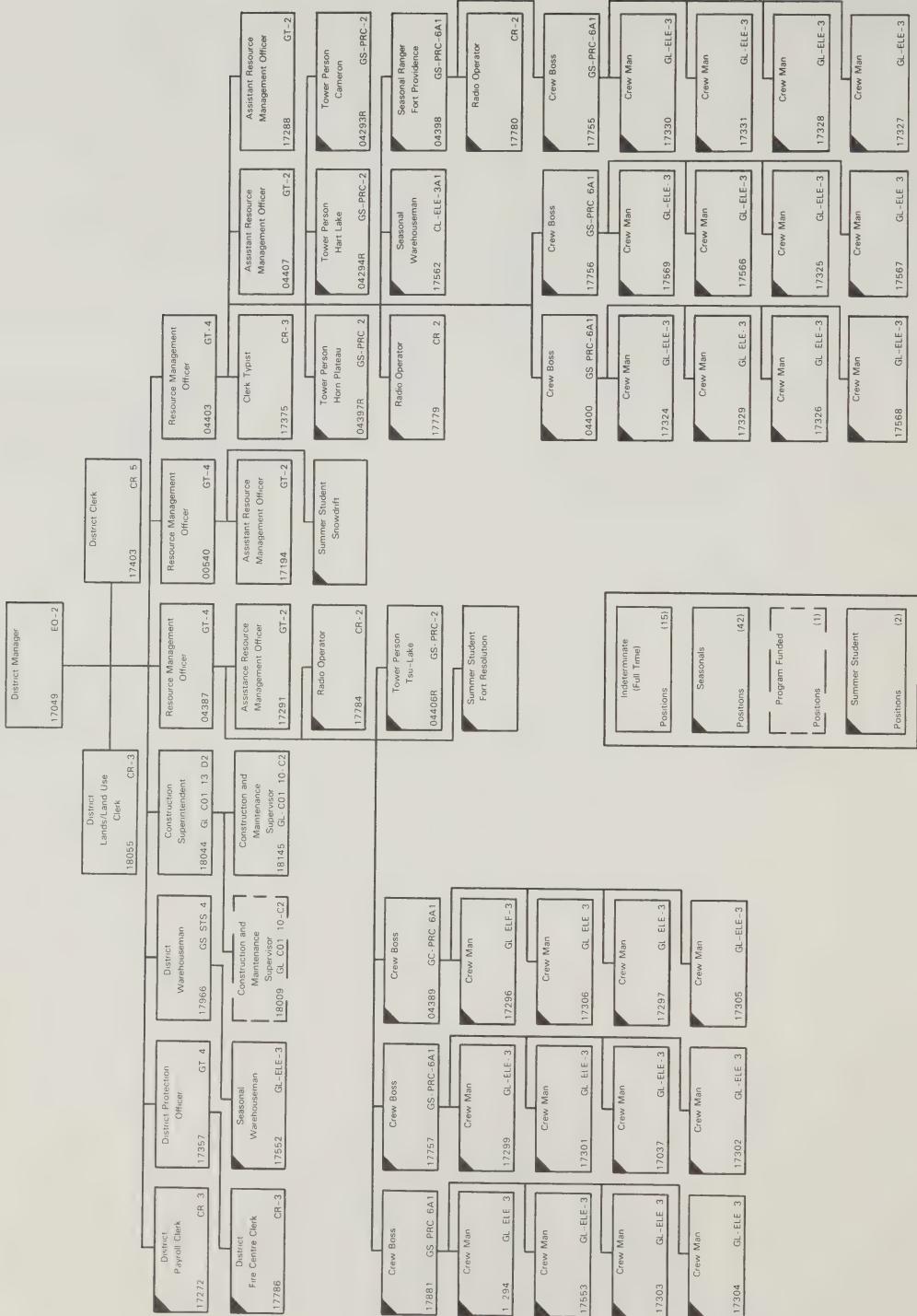


Figure 3.3: Organization Chart, Fort Smith District.

Zones 1, 2, and 3. The area figures are based on 1977 statistics provided by the Regional Fire Centre. The total area of the Mackenzie District of the Northwest Territories is defined in the fire management manual as 1 366 194 sq. km. (527,490 sq. mi.) and consequently the non protected area should be shown as 1 142 125 km² (440,977 sq. mi.).

The table following shows the priority zone areas in the Fort Smith District.

Fort Smith District Area of Priority Zones

	km ²	Sq. Miles
Priority Zone 1	13 227	5,107
Priority Zone 2	22 046	8,512
Priority Zone 3	27 713	10,700
Protection Area	62 986	24,319
Priority Zone 4 (Non Protected)	149 010	57,533

In the Northwest Territories in 1977, 1978 and 1979 fires were not fought in Priority Zone 3 unless life and property were in imminent danger or resource values in the higher Priority Zones 1 and 2 were threatened. This interpretation of policy removed initial attack action on small fires and in effect converted Priority Zone 3 into a non-protection area. The actual protected area for the Fort Smith District in 1979 was therefore only the total area of Priority Zone 1 and 2 or 35 273 km² (13,619 sq. mi.).

3.3 Fire Statistics

3.3.1 Fires by Priority Zone — 1970-1979

Fires by Priority Zone - 1970-1979 Fort Smith District Number of Fires

YEAR	ZONE 1	ZONE 2	ZONE 3	ZONE 4	TOTAL
1970	16	27	54	11	108
1971	24	30	66	14	134
1972	21	27	40	23	111
1973	22	22	52	46	142
1974	17	11	8	4	40
1975	9	9	37	4	59
1976	12	18	20	29	79
1977	61	37	7	11	116
1978	35	16	14	19	84
1979	40	53	32	54	179

The 179 fires that occurred in the 1979 fire season were the greatest number in recorded history. The 53 fires in Priority Zone 2 were the highest recorded for that zone in the past 10 years. The number of fires reported in Priority Zones 1 and 2 are considered to be reasonably accurate. Because Priority Zones 3 and 4 do not have adequate detection facilities we believe that many fires have occurred which are not recorded.

3.3.2 Number of Fires by Priority Zone

Number of Fires by Priority Zone and Sub-District

1979				
PRIORITY ZONE	FORT SMITH SUB-DISTRICT	HAY RIVER SUB-DISTRICT	CARIBOU SUB-DISTRICT	TOTAL
1	20	19	1	40
2	31	22		53
3	28	4		32
4		8	46	54
TOTALS	79	53	47	179

The Fort Smith Sub-District had the largest number of fires to action while the Caribou Sub-District had the fewest because of Priority Zone 4 fires which were not fought.

3.3.3 Number of Fires Fought by Priority Zone

Number of Fires by Priority Zone and Sub-District

1979

PRIORITY ZONE	FIRES FOUGHT	FIRES NOT FOUGHT	TOTAL
1	40	—	40
2	48	5	53
3	15	17	32
4	---	54	54
TOTAL	103	76	179

The 15 fires that were fought in Priority Zone 3 included 5 fires that threatened Priority Zones 1 and 2 and 10 small fires that were thought to be in Priority Zone 2 or to be a threat to Priority Zone 2.

3.3.4 Area Burned by Priority Zone

Area Burned by Priority Zone Fort Smith District 1979

PRIORITY ZONE	AREA (ha)	AREA (acres)
1	24 177	59,741
2	99 756	246,497
3	828 132	2,046,314
4	450 885	1,114,137
TOTAL	1 402 950	3,466,689

Ninety-one percent of the area burned was in Priority Zones 3 and 4 where fires were generally large and uncontrolled. Fires SM33 and SM41 in Priority Zone 2 were discovered too late for initial attack and received limited fire action. As a result they became large and accounted for 91 497 ha (226 093 ac.) of the 99 756 ha (246 502 ac.) burned in Priority Zone 2 and consumed 30% of the mature timber volume in the Slave River Valley. Fires that received no initial attack when small, accounted for 97.7% of the total area burned in all Priority Zones.

3.3.5 Fire Occurrence by Month and Year — 1970-1979

The fire occurrence in the past decade in the Fort Smith District show 86% of fires in the months of June, July and August. (Table 3.1)

A more refined breakdown of statistics would define more specifically when the fire buildup was significant in June. For example, in 1979 80% of the June fires occurred after the 15th day. Resource levels and preparedness should be adjusted to meet the anticipated average monthly fire occurrence. Weather information must also be a key guide to the possibility of exceptional earlier buildup of hazard.

**Table 3.1: Fort Smith District
Fire Occurrence by Month and Year
1970-1979**

YEAR	JAN.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.	OCT.	NOV.	TOTAL
1970				7	28	59	11	3			108
1971	1		1	5	27	55	33	9	3		134
1972			2	4	22	46	33	4			111
1973				9	45	33	45	3	6	1	142
1974			1	6	14	8	7	3	3		40
1975			1	1	16	37	3	1			59
1976				7	14	35	20	3			79
1977			2	14	36	29	15	12	8		116
1978	1	1	9	53	7	9	3	1			84
1979				9	52	70	43	12	1		179
TOTAL	1	1	8	63	307	379	219	53	20	1	1052

3.3.6 Fires, Areas and Costs

Although the number of fires and area burned in 1979 was the highest in the past ten years, the total cost of fires in 1971 and 1972 in the Fort Smith District was much higher than 1979. The resources in manpower, aircraft and equipment used in 1971 and 1972 were also greater than in 1979.

In 1971 the Forest Service carried out a massive air and ground attack on forest fires at double the costs of 1979. The high costs were not only the result of an overload of forest fires but also the inability of the fire organization to supervise the increased workload especially in the field of aircraft cost control.

It is important to be able to take decisive action as needed. Savings should be sought through control of expenditures on the high-cost items such as aircraft and retardant, not through a general diminishing of effort irrespective of resource values.

Number of Fires, Area Burned and Costs 1970-1979*

Fort Smith District

YEAR	NUMBER OF FIRES	AREA BURNED (ha)	AREA BURNED (acres)	TOTAL COST
1970	108	187 515	463,350	768 644
1971	134	575 910	1,423,073	3 930 928
1972	111	113 370	280,137	2 079 421
1973	142	153 900	380,287	689 191
1974	40	158	390	83 470
1975	59	30 445	75,230	634 031
1976	79	176 163	435,299	197 441
1977	116	111 830	276,332	350 843
1978	84	74 470	184,015	331 644
1979	179	1 402 950	3,466,689	1 899 488

*Includes zones 1, 2, 3, and 4.

3.3.7 Firefighting Costs

The following Table 3.2 indicates some of the high costs of fighting forest fires. In the Fort Smith District 70% of the costs were associated with aircraft use especially helicopters that are essential in the North country to transport men into otherwise inaccessible areas. Wages for firefighters were the second highest feature at 20.5% while food, lost equipment and miscellaneous totalled 9.5%.

**Table 3.2: Fort Smith District
1979
Total Fire Fighting Costs
by Sub-District**

FORT SMITH SUB-DISTRICT	HAY RIVER SUB-DISTRICT	CARIBOU RANGE SUB-DISTRICT	DISTRICT TOTAL
Tanker Aircraft	122 475.99	50 532.30	3 600.00
Retardant	104 102.10	38 905.75	960.00
Helicopters	532 954.39	189 711.62	1 053.45
Fixed Wing Aircraft	125 735.49	44 093.11	18 042.47
Wages	305 161.11	82 576.70	2 532.28
Groceries	61 058.70	39 127.70	423.77
Fuel	67 015.82	29 467.28	26.51
Equipment Loss	16 221.19	3 307.44	-----
Misc.	12 760.54	47 642.76	-----
TOTAL	1 347 485.33	525 364.66	26 638.48
			1 899 488.47

Chapter 4 Fire Situations – Fort Smith District 1979

4.1 Introduction

The fire situation chapter gives perspective to the many events and problems that occurred during the 1979 fire year. Included are major events that took place during the season, a daily fire load indication related to firefighting resources, and reviews of specific fires that were considered by the Panel to represent fire conditions in 1979. The sequence of events gives a brief review of highlights.

4.2 Sequence of Major Events

May 24

First fire of the season occurred. May was below average in fire occurrence.

June 12

First lightning storm of the season occurred.

June 15

A large fire discovered in Alberta on Andrew Lake and the Alberta Forest Service informed. This fire was out of control and later moved into the Fort Smith District to become part of Fire SM2.

June 17

Lightning caused 11 fires. Five fires in Priority Zones 1 and 2 were actioned and six in Priority Zones 3 and 4 were not actioned.

June 21

Second major northern Alberta fire reported which later crossed into the Fort Smith District.

June 28

Low visibility 0-5 km in Fort Smith area due to smoke drift, grounds all air operations. Lookouts during heat of day gave reduced detection service. Action on going fires affected by grounding of aircraft. Thirteen days in July had 0-5 km visibility in Fort Smith area. Surrounding areas had a more variable visibility.

June 30

Two A20 air tankers with birddog aircraft arrive from the Yukon Territory to assist. One fire was actioned before the group returned to home base on July 1.

July 1

Fire SM33, Priority Zone 2 in Grand Detour timber was first detected when it was already 8,000 acres in size. Heavy smoke was a constraint to detection. Fire not actioned due to other commitments and shortage of firefighting resources.

July 2

Staff planning meeting decided that no large fires would be actioned in any zone unless they threatened life or property. This ruling was subject to change if fire hazards and workloads lessened.

July 7

Fire SM41, Priority Zone 2 in Grand Detour timber area moved from Wood Buffalo National Park on a four mile front and had burned 8,000 acres on discovery. Fire not actioned due to its large size and shortage of firefighting resources.

July 12

One DC6 air tanker with birddog aircraft on loan from B.C. until July 19. One additional DC6 airtanker from B.C. was in the Northwest Territories for two days.

July 22

Harry Daniels, President, Native Council of Canada, hired 23 men from Salt River and fought fire at Grand Detour for two days. Fire was not being actioned by the Forest Service at the time.

July 23

Shortage of aircraft fuel in Fort Smith District. DC6 flew in 48 drums JP4 from Norman Wells.

July 27

Hunters and Trappers Association met with Minister of Indian Affairs and Northern Development in Ottawa regarding fire emergency in Fort Smith District.

July 28

Continued expressions of concern by the HTA regarding fires in the Caribou Sub-District and in trapline areas of Priority Zone 3.

Pete Ferguson appointed as Liaison Officer by Minister of Indian and Northern Affairs to review the fires and the control action and keep the public informed on the Fort Smith fire situation.

August 1

Public meeting held in Fort Smith town hall by Pete Ferguson to advise the mayor, the press, and the public of the fire situation. Representatives of the Hunters and Trappers Association did not attend.

August 2

Decision made by Fort Smith District Forest Service staff not to action any large fire unless a community was threatened.

August 14

Fire HY41 discovered and reached 1,000 acres in size same day. Town of Pine Point threatened by the fire eight miles distant. Supervisory team brought in from other NWT districts to manage firefighting operations.

August 15

No additional helicopters available for initial attack on new fires.

Fire buildup index indicating fuel moisture deficit reaches maximum of 111.

Contract DC6 air tanker flew 9.9 hours on fire activity with 32,500 gallons of long term retardant dropped which was maximum for any one day.

August 16-22

Three "Tracker" air tankers and Birddog aircraft arrive from Saskatchewan to assist in fire control.

August 16

Fatigue and shortage of firefighting resources reaches peak.

August 17

Fort Smith registers a daily temperature high for Canada at 30°C. Peak fire load of 19 fires burning in Zones 1, 2 and 3. DC6 air tanker attacked 8 new fires with retardant prior to arrival of ground crews. Pine Point fire out of control. New defensive firebreak established at town.

August 18-27

Significant amount of precipitation reduces fire hazard in light fuels to zero. Mop up of fires gets underway.

August 21

Special meeting called by Town Council at Fort Smith on behalf of hunters and trappers. Fire information provided by Liaison Officer Ferguson. HTA representatives did not attend.

September

Twelve fires occurred but no control problems.

October 4

Last fire of the season.

4.3 Fire Load Considerations

4.3.1 Introduction

In order to review the fire situations of June, July and August 1979 in the Fort Smith District the Panel prepared the following Table 4.1. The purpose was to indicate sequential fire occurrence and its relationship to the firefighting resources available at the time. A review of past performance provides some new perception for future fire control improvement.

4.3.2 Fire Occurrence

Drought weather conditions and high lightning occurrence were responsible for 80% of the 179 fires that occurred during the fire season. The critical periods that produced extreme fire loads were from June 27 to July 10 and August 16 to August 20. High fire loads were present from July 10 to August 16 as a result of action on large fires threatening from Priority Zone 3 rather than from new fires occurring. Fires SM22, SM26, SM28 and SM42 in Priority Zone 3 and fire SM33 in Priority Zone 2 received much of the firefighting action during the last half of July and the first half of August. The Zone 3 fires did not receive initial attack because at the time of occurrence they were not seen as a threat to resources in Priority Zone 1 and Zone 2. The continuous fire activity persisted for 75 days.

Table 4.1: Fire Load Considerations
 Fort Smith District
 June 1979

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
(1) New Fires	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	5	0	0	0	0	0	4	1	0	0	2	4	0	6	4
(2) Fires Out	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	1	2	0	2	0	0	0	4	1	0	2	0	4	
(3) Actioned Fires Burning	0	0	0	0	0	0	1	1	1	1	1	3	1	0	0	0	5	4	2	2	0	4	5	5	1	2	6	4	10	10	
(4) Partial Action Fires Zone 2 and 3																															
(5) Total Fires Receiving Action	0	0	0	0	0	1	1	1	1	1	1	3	1	0	0	0	5	4	2	2	0	4	5	5	1	2	6	4	10	10	
(6) Men on Fires	0	0	0	0	0	4	0	0	0	0	14	10	0	0	0	0	31	23	9	4	1	29	25	32	5	10	5	20	25	25	
(7) 5-Man Crews on Standby for New Fires	7	6	6	6	6	7	7	6	6	6	6	4	8	7	6	6	4	6	7	7	6	2	2	6	7	7	4	7	2		
(8) Fixed Wing Aircraft on Fires																															
(9) Helicopters on Fires																															
(10) Helicopters Available for New Fires	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	3	2	2	2	1	2	3		
(11) Build Up Index	34	48	51	56	59	59	63	65	68	72	72	79	82	71	73	80	82	64	68	69	74	77	80	79	82	87	92	95	100		
(12) Fire Weather Index	10	11	13	12	28	26	36	17	18	29	4	9	17	20	18	13	24	19	8	10	13	17	13	10	6	15	24	22	32	49	

Fire Load Considerations
Fort Smith District
July 1979

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
(1) New Fires	1	1	1	0	0	0	3	1	1	1	0	1	1	0	1	2	0	0	2	0	0	0	0	0	0	0	0	0	2	1		
(2) Fires Out	0	2	3	0	2	0	1	1	1	2	3	0	1	2	1	0	0	1	2	1	0	2	0	0	0	0	0	1	0	0		
(3) Actioned Fires Burning Zone 1 and 2	7	6	4	5	3	3	5	5	5	4	1	2	2	1	1	1	2	3	1	2	2	0	0	0	0	1	1	1	2	3		
(4) Partial Action Fires Zone 2 and 3	0	0	1	2	1	1	2	1	1	2	3	2	2	2	2	3	3	2	3	3	2	3	3	3	4	4	4	4	5	5		
(5) Total Fires Receiving Action	7	6	5	7	4	4	7	6	6	5	3	5	4	3	3	3	6	6	4	4	4	5	3	3	4	5	5	4	5	7	8	
(6) Men on Fires	54	44	41	35	22	40	53	69	68	45	60	55	65	75	74	75	60	52	49	47	71	68	83	88	90	91	90	85	65	83		
(7) 5-Man Crews on Standby for New Fires	2	5	7	5	6	8	6	4	4	7	5	5	5	4	5	5	5	6	5	5	6	4	5	3	3	4	4	4	4	3		
(8) Fixed Wing Aircraft on Fires (including patrol)	0	0	4	5	4	2	3	2	2	3	2	3	4	3	2	3	1	2	1	4	0	2	3	2	2	0	0	2	3	3		
(9) Helicopters on Fires	2	2	1	1	2	1	2	2	2	2	1	3	3	3	1	3	3	3	3	3	3	3	3	4	4	6	5	5	4	5		
(10) Helicopters Available for New Fires	2	3	4	2	3	2	2	4	2	2	2	2	3	4	4	4	4	7	4	4	4	4	4	3	4	3	1	4	3	2	1	3
(11) Build Up Index	102	102	82	81	86	89	96	98	66	67	71	74	75	77	81	84	88	92	97	99	101	58	55	59	63	65	70	75	78	86	86	
(12) Fire Weather Index	47	40	2	12	24	29	30	29	2	5	12	19	13	18	16	17	20	18	23	20	23	0	2	5	10	12	18	22	20	16	20	

Fire Load Consideration
Fort Smith District
August 1979

	DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
(1) New Fires	0	0	0	0	1	0	0	0	0	3	0	2	2	3	8	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	1		
(2) Fires Out	1	1	0	1	0	1	0	0	0	0	1	0	0	3	0	1	0	1	2	5	4	2	0	0	2	0	1	1	1	0	0		
(3) Actioned Fires Burning Zone 1 and 2	2	1	1	0	1	0	0	1	1	0	0	3	0	2	3	6	13	11	8	6	5	5	3	5	3	3	3	2	3	2	1	1	2
(4) Partial Action Fires Zone 2 and 3	5	5	4	4	3	2	3	3	4	2	2	2	2	3	1	2	6	2	3	1	1	1	1	1	0	0	0	0	0	0	0	0	0
(5) Total Fires Receiving Action	7	6	5	4	4	2	3	4	5	2	2	5	2	5	2	5	4	8	19	13	11	7	6	6	6	4	4	2	3	2	1	1	2
(6) Men on Fires	69	64	75	49	50	37	39	50	54	49	44	44	44	43	38	105	113	135	134	136	140	145	147	148	110	114							
(7) 5-Man Crews on Standby for New Fires	3	4	3	3	2	3	4	5	5	4	4	5	4	3	3	3	3	1	3	3	3	4	3	3	5	4	7	6	5	5	4		
(8) Fixed Wing Aircraft on Fires	2	5	4	4	1	1	3	1	2	3	1	1	2	3	5	4	1	3	3	2	3	1	2	1	2	1	1	--	--	--	--		
(9) Helicopters on Fires	4	4	3	2	2	2	3	3	2	2	2	2	4	5	6	4	7	6	6	6	6	6	3	2	2	1	1	1	1	1	1	1	
(10) Helicopters Available for New Fires	4	3	4	6	6	5	4	3	5	2	3	4	3	2	0	2	1	3	2	3	4	4	4	3	2	2	2	2	2	2	2	1	
(11) Build Up Index	79	82	83	88	90	91	92	90	93	99	101	101	107	107	111	95	98	102	78	73	72	53	43	38	--	--	--	--	--	--	--		
(12) Fire Weather Index	18	14	14	20	24	20	14	18	18	19	29	21	25	24	28	12	15	12	15	1	2	5	1	1	0	--	--	--	--	--	--		

4.3.3 Fire Weather

In the Northwest Territories the fire weather factors of rainfall, relative humidity, wind and temperature are integrated to compute the Canadian Fire Weather Index. There are several factors within the fire weather forecast system that provide relationships between forest fuels and moisture conditions. The two most commonly used for day by day fire administration are the Fire Weather Index and the Buildup Index.

The Fire Weather Index reflects as a numerical rating the likelihood of a fire starting should there be a source of ignition. Figure 4.1 indicates the daily fluctuation of the Fire Weather Index with the peak occurring on June 30. The Index was high to extreme during the season except for three short drops in July and August.

The Buildup Index shown as Figure 4.2 represents the total amount of fuel available for combustion and it is less subject to daily fluctuation. Only sustained and significant amounts of precipitation will cause the Buildup Index to drop. The peak buildup of drought was on August 15 with an extreme rating of 111. The Index remained at high to extreme throughout most of the season.

Showers did occur during June, July and August and their time and effect is well represented by change in the Fire Weather Index Figure 4.1. It should be noted on the charts how rapidly the fire danger decreased near the end of August.

Fire weather reports ended for the season on August 25. There were reports that many large fires were still burning strongly in September in Priority Zones 2, 3, and 4. It would have been advantageous to continue the fire weather information for September to obtain a correlation with reported fire activity. Satellite imagery should be obtained in the Spring of 1980 after the snow has left burned areas and compared with 1979 imagery of early September. The difference should help to define the amount of fire spread during September.

The concept of reduced action as a cost saving procedure on fires in September and October is satisfactory providing the rate of fire spread is minimal.

There were five major fuel and meteorological situations that were in conjunction during the critical summer of 1979 (Stashko and Harvey, 1980). The five key factors were, a slow green up of coniferous fuels, a long dry period in May and June, dry lightning ignition, high sustained winds and a persistent drought.

The dry period in June that resulted in a continuing drought into July and August is shown in Figure 4.3.

The surface weather pattern from June 29 to July 6 is depicted in Figure 4.4. The upper frontal system was blocked by a surface high resulting in dry lightning storms along the Alberta, Saskatchewan and the Northwest Territories border area. Resistant, strong southeasterly winds were also caused by the same weather pattern.

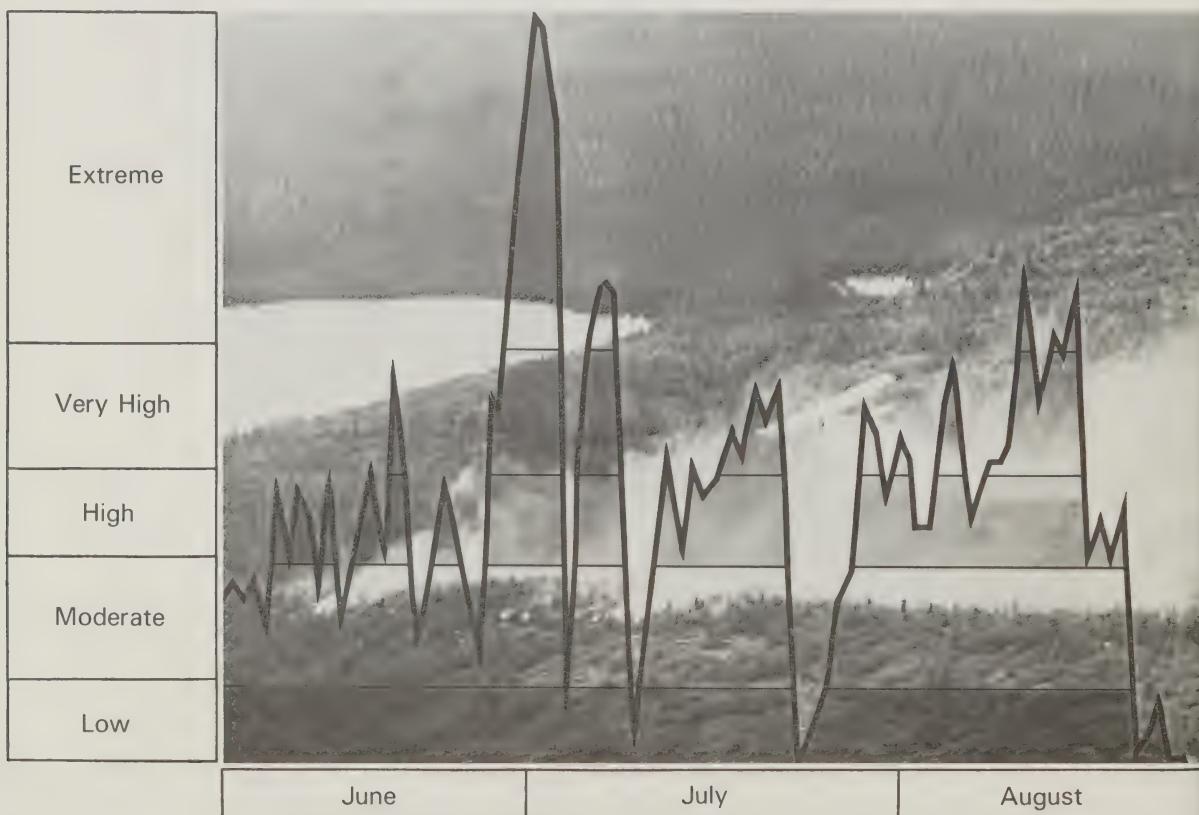


Figure 4.1: Fire Weather Index, Fort Smith District. 1979

4.3.4 Manpower

Eight 5-man initial attack crews on standby during June 1 to June 15 were more than adequate to extinguish the few fires that occurred. In addition to the number of crews shown on standby there was one crew on time off each day. The attack crews on standby during the remainder of the season were adequate in number to meet the fire situation in the reduced Protection area of Priority Zones 1 and 2 with the exception of August 18 when only one crew was left to attack new fires. Trained crew foremen were in short supply and as the fire load increased it became necessary to place suppression crew members in charge of new standby crews formed. The majority of the firefighters were extra men hired temporarily to meet the emergency. At the peak day of August 28 there were 148 men on fires of which 99 were extra firefighters. Fifty six of the 148 man total were on the Pine Point fire. Demanning of fires commenced at this time.

During the last half of June the numbers of men on fires as shown on the fire load chart appears very low and variable. In September, fire suppression action and manning of fires was not a high priority because of the low fire hazards present.

The number of certified firefighters on the fires is not known however the Fort Smith District staff has trained and certified some 48 men as firefighters over the past three years. To meet the de-

mand for manpower many untrained persons were necessarily used. Manpower resources of trained available people were depleted in the Northwest Territories, and by mid August the heavy fire load and long hours of work without relief resulted in fatigue and reduced capability among firefighters and supervisors.

On July 13 and July 15 requests for manpower and overhead assistance were made to the Alberta Forest Service. Due to their own heavy fire load Alberta was unable to comply.

4.3.5 Aircraft

Helicopters available to take initial action crews to new fires were adequate to meet the existing fire situation except for August 15 when all machines were in use. There were insufficient helicopters to meet other demands for equipment supplies, reconnaissance and the movement of men on fire lines. The shortage resulted in long hours of flying for individual pilots and delays in action. Poor visibility due to smoke was a constraint to fire aircraft use for 13 days in July. Fixed-wing aircraft availability and demand was less critical than for helicopters. Fixed-wing aircraft were used for fire patrol and the movement of men and equipment to and from fires.

The DC6 air tanker was highly effective in attacking and holding small fires prior to the arrival of the helicopter attack crews. Fifty-

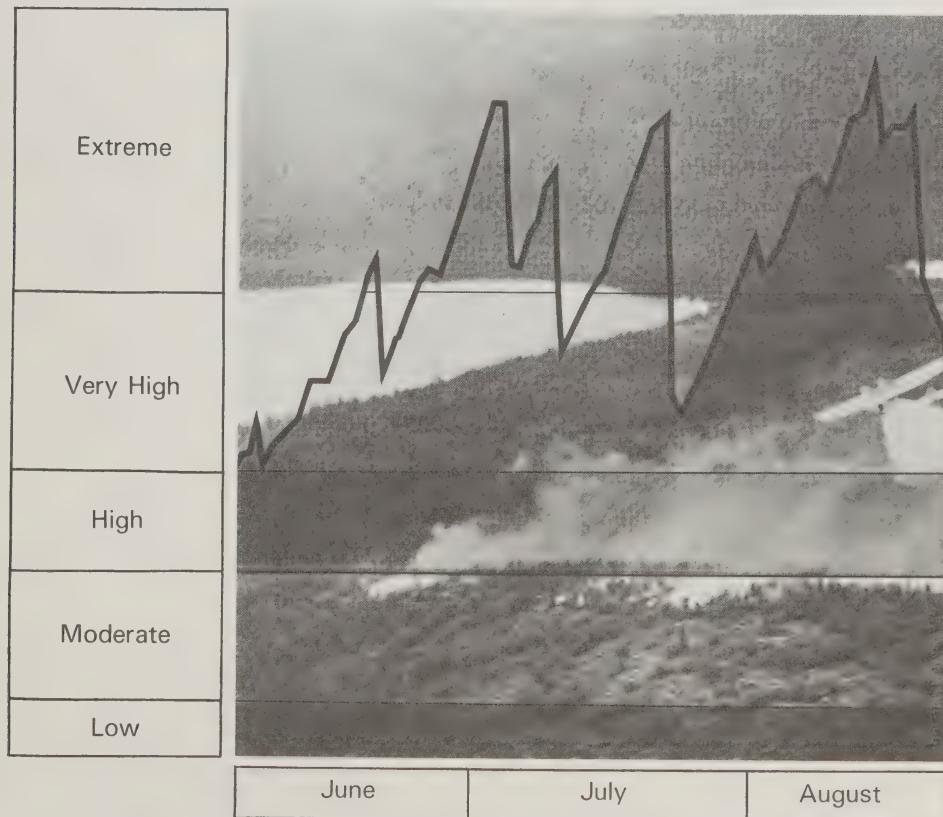


Figure 4.2: Fire Buildup Index, Fort Smith District. 1979

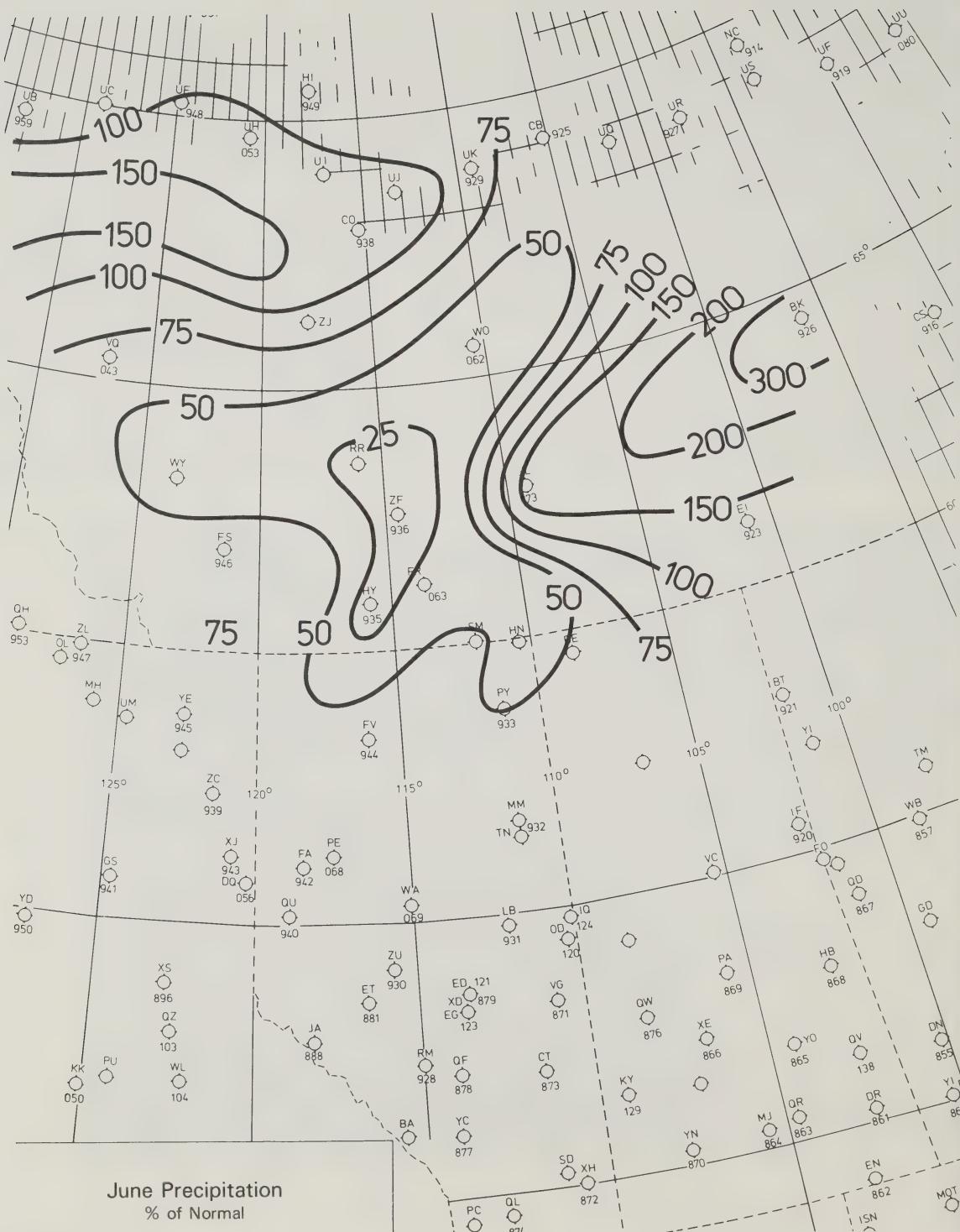


Figure 4.3: June Precipitation.

Mean Surface Weather Pattern
June 29 — July 6, 1979
Isobars Labelled in Millibars

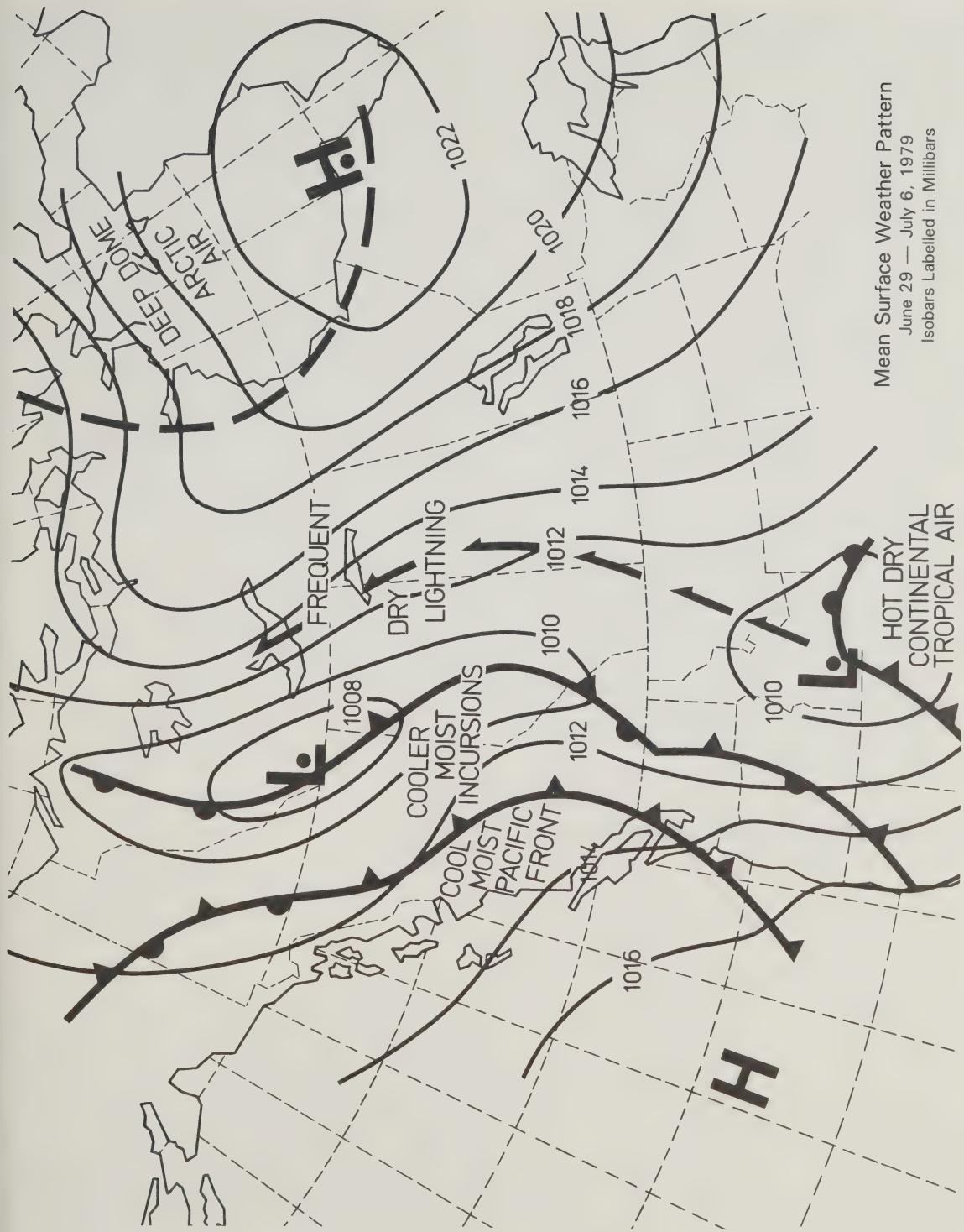


Figure 4.4: Mean Surface Weather Pattern — June 29-July 6, 1979.

four fires were attacked with long term retardant and 41 of the sorties were made before the arrival of other forces at the fire. The presence of the tanker was particularly important on peak fire load days. The long term retardant used was successful in holding lightning strike fires for periods of up to twenty hours. The retardant was most effective in light fuels. There is concern among all fire agencies relative to the cost-benefits of using long term retardant. Many are considering abandonment or reduced use. An analysis needs to be made in the Northwest Territories to determine future direction in the use of retardants. A summary of 1979 retardant and water use is included in the appendix.

One air tanker group was loaned by Yukon Territory. However, it was only used on one fire then returned to base. There was a difference in operational procedures that caused the problem. The same tanker group operated successfully on 9 fires in Alberta and on 15 fires in British Columbia. In emergencies some flexibility in procedures is necessary as long as safety of life is not threatened. There is a need for improved communication cooperation and development of mutual assistance procedures between the Northwest Territories and Yukon.

4.4 Representative Fire Review

4.4.1 Introduction

The fire policy of the Northwest Territories calls for a team to review all wildfires that have exceeded the expenditure limit for the priority zone in which the fire started. The cost limits established for Priority Zones 1, 2, 3 and 4 are \$50 000, \$50 000, \$30 000 and \$20 000 respectively. In addition any other fire or groups of fires may be reviewed if improvements to future fire control operations are a likely result.

The Panel selected four representative wildfires that occurred in the Fort Smith District and requested that the Forest Service review them at the public meetings held in Fort Smith in December. The material on the following pages of this section reflect the information gathered and the opinions of the Panel.

4.4.2 Caribou Range Sub-District Fire SM2

Fire Statistics SM2

Location	Priority Zones 3 and 4 in Caribou Range Sub-District
Fire Started	June 17, 1979
Cause	Lightning
Fires Integrated into SM2	CR1, CR4, CR5, CR7, SM7, SM16, SM29, SM30, SM34, SM35, SM36
Area Burned - Fort Smith	725,399 ha
District	(1,792,500 acres)
Fire Out	October 8, 1979
Fire Cost (Patrol only)	\$2 816

Fire SM2 was reviewed by the Panel because of its vast size and the public concern involved. No action was taken to control the fire. SM2 was an amalgamation of at least twelve fires which were burn-

ing out of control in Priority Zones 3 and 4 from the latter part of June to October. The Caribou Range Sub-District in the Fort Smith District has had a long history of large and frequent fires. In the 65 km by 130 km (40 mi. by 80 mi.) area covered by fire SM2, it is estimated that 165 fires have occurred during the past decade with a total burn and reburn area of 1.3 million ha (3.2 million ac.). The area of fire SM2 is shown in Figure 4.5.

The topography of the area is relatively flat with natural barriers consisting of lakes, rivers, streams, rock and some swamp areas. The landform is the precambrian igneous bedrock with some sedimentary and volcanic intrusions. There is a shallow depth of glacial till over the higher rock structures and the soil is deeper over low lying areas. During drought conditions, only large lakes form natural barriers to fire, and ground or aircraft control forces must establish fire barriers between lakes.

The Caribou Range Sub-District is only accessible by air or boat during the summer season. The distances, in excess of 100 km (60 mi.) from Fort Smith make fire control access impractical without helicopter or fixed-wing float aircraft. An effective initial attack capability would require a fire base establishment within the Caribou Range District.

The fuels in the fire area were white and black spruce mixed with birch, poplars, jack pine, sedges, grasses and caribou lichens. Bog and muskeg areas are present at the lower elevations. The surface fuels are light to medium in size and are characterized by rapid rate of spread. They have a generally low resistance to control because they are greatly influenced by humidity. The flame length, and the amount of fire is significantly reduced with increased humidity in the air.

The fire hazard in late June was very high to extreme and remained at that level during most of July and August. The long periods of high temperature and low humidity dessicated the forest fuels and created an explosive situation. The fire weather was also characterized by periodic lightning storms that provided an ignition source and started fires throughout the Fort Smith District.

Value of Resources Destroyed

RESOURCES	\$	REMARKS
Fur Revenue	115 000	Forest Service Estimate
Cabins (11 destroyed)	22 577	HTA Estimate
Trapping Equipment	38 025	HTA Estimate
Household Goods	9 895	HTA Estimate
Food and Misc.	5 033	HTA Estimate
TOTAL	190,530	

The resource values in Priority Zones 3 and 4 in the Fort Smith District are relatively low according to the fire control policy. A corollary is that expenditures of large sums of money for fire suppression cannot be economically justified where values are low. The resource value criteria in Priority Zones 3 and 4 include human life, furbearer and game habitat, 21 trappers cabins, 3 fishing lodges, summer mining exploration camps, winter caribou range, unique recreation areas, areas of high erosion potential, high quality timber sites, valuable and potentially valuable domestic watersheds. Although the resource values are worthy of mention in fire management criteria, there is an overriding policy consideration that limits suppression action to fires that directly threaten life and property or if resource values in Zones 1 and 2 are threatened. In other words, suppression action in the Caribou Range District will be taken near cabins and lodges only when fire actually is threatening their existence. There is

no arrangement for aggressive initial attack on fires in Zones 3 and 4 unless values in Zones 1 and 2 are under threat from the fires. As a result the fires that eventually comprised Fire SM2 did not receive initial attack or any effective follow-up action. The SM2 fire was monitored when visibility permitted and information was made available to the public. Defensive action was taken to protect three cabins at Elbow Lake, Lady Gray Lake and Oulton Lake.

The total area burned in fire SM2 by Forest Service calculations was 725 399 ha (1,792,500 acres). These figures do not include loss of forest cover, trapline improvements such as trails or the loss of revenue during the time that is required for the area to again support for animals.

The SM2 fire burning in the Caribou Range area of Priority Zones 3 and 4 was a great concern to trappers and hunters. They watched with frustration as fires developed without action being taken by the Forest Service to stop them when they were still small and controllable. They saw cabins, equipment and traplines destroyed, and could envision loss of livelihood until that time in the future when the forest was renewed which in effect would be never for many of them.

The prime constraint to action on fires by the Forest Service in Priority Zones 3 and 4, was the fact that for financial reasons no action would be taken unless life or property was directly threatened or if fires from Priority Zones 3 and 4 threatened resources in Priority

Fort Smith — Nonacho

NTS. No. 75 SW

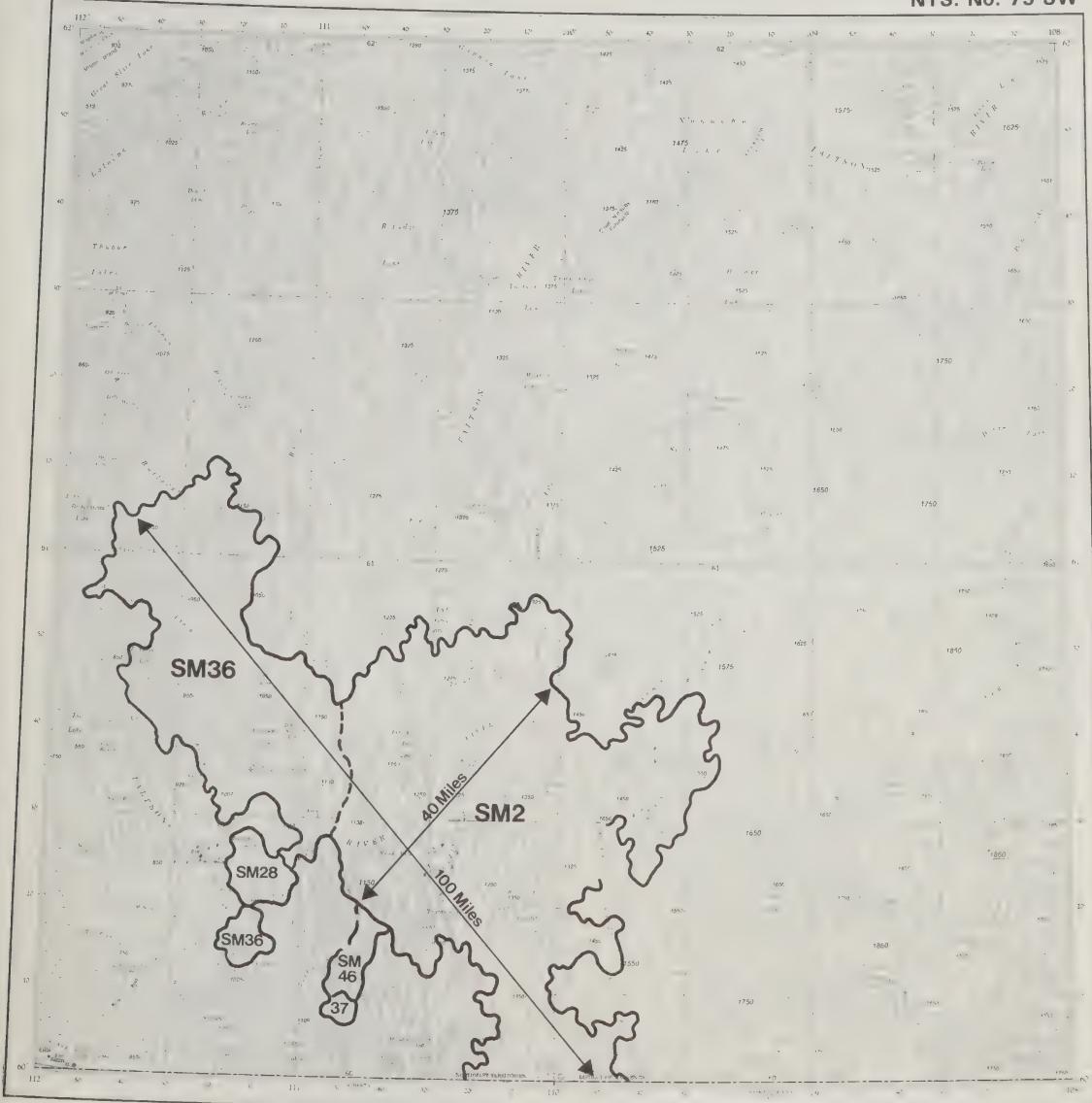


Figure 4.5: Fire area SM2 Caribou Range.

Zones 1 and 2. Other constraints such as poor visibility, lack of firefighting resources, and lack of funds were less significant in the light of the overriding economic restriction.

4.4.3 Grand Detour Fire SM33

Fire Statistics SM33

Location	Hay River Sub District
Fire Cause	Lightning
Started	June 29, 1979
Discovered	July 1, 1979
Size at Discovery	3 200 hectares (8,000 acres)
Final Size	33 600 hectares (83,024 acres)
Date of Extinguishement	September 7, 1979
Timber Volume Lost	28.1 million board feet
Damage Estimate (Forest Service)	\$400 000
Firefighting Costs	143 600

The Grand Detour fire which occurred in Priority Zone 2 east of Fort Smith on the Slave River, was of particular concern to the Panel because of the timber resource involved. The fire area is shown in Figure 4.6 which also indicates location of adjacent 1979 fire SM41.

Assured rapid access to the area was by helicopter or float equipped fixed wing aircraft. There is a winter road leading to Grand Detour which is normally impassable to conventional vehicles in the summer. It was reported that the fire site was so dry that vehicles could have been used. Access by boat was also possible.

The land was relatively flat and natural fire barriers consisted of rivers and streams. Swamps and sloughs were too dry to be effective.

Alluvial soil along the river supported a fuel type of mature and immature white spruce interpersed with bog areas of black spruce and open meadows of grass and brush. Drought conditions had lowered the ground water level. Fires burned deeply into the ground and were highly resistant to control.

The temperatures in late June were in the high twenties, winds were often 24 km per hour (15 mph) and the fire hazard was extreme. Drought conditions were in effect at the time of the fire and conditions were explosive. Lightning occurred on June 26, 28 and 29.

The fire history of the area showed a total of 8 fires from 1970 to 1978 and a burn of only 118 ha (295 ac.). The presence of mature and overmature spruce also suggested a low fire occurrence and burn pattern in the past.

The resource values in the area were timber, fur and recreation.

The volume of merchantable timber in the fire area was estimated at 28 million board feet. The area was trapped regularly by persons from Fort Smith. Recreationists used the area for camping and for hunting.

Low visibility caused by smoke from Alberta and Wood Buffalo National Park fires prevented early detection of the fire which at time of discovery was about 3 200 ha (8,000 ac.) in size. Although the fire was in Priority Zone 2, it was not actioned for the following reasons:

- Available resources of manpower and equipment were already committed to other fires on July 1.
- Smoke was restricting visibility and field operations.
- New lightning fires were forecast.

- The fire was large and would require large resources of manpower, equipment and aircraft to control.

The fire was monitored and had northwest winds occurred, it was planned to take defensive action on the south flank in case the fire started moving towards the Salt River Settlement. On July 17 the fire was assessed and it was noted that the southern and eastern perimeters had burnt themselves out. From July 23 to August 17 defensive action was taken on the fire to protect trappers cabins that were threatened. The fire weather became more severe on August 17, and a fire base camp was burned out. The fire was abandoned until September 2-7 when "mop-up" occurred.

The following problems with fire SM33 were noted by the Fire Review Panel:

- The discovery time of the fire was unacceptable because there was a lapse between the estimated starting date and the time the fire was reported. The fire was then 3 200 ha (8 000 ac.) in size.
- There were insufficient resources in manpower, aircraft and equipment to take any significant or effective action on the fire. Seven small fires were being fought in Zones 1 and 2 on July 1. The Fort Smith District was equipped for initial attack only and was not able to fight a large fire at the same time.
- Supervisors experienced in fire behaviour, fire analysis and fire line organization were in short supply when firefighting did start.
- Trained fire line crews with adequate service support were not available and problems in timekeeping and feeding developed. Adequate drinking water was not available.
- Fire line construction was so slow that burning out could not be accomplished prior to flareup and loss of line. Suppression costs were high. No airtankers for retardant drops were used.
- Lack of a safe or suitable camp location as a fire base was noted as a problem. The loss of the base camp reflected that situation.
- Concern over the loss of mature timber was not indicated as a suppressor priority during the fire review. Life and other property were given a higher priority.
- The decision made on August 2 not to fight large fires anywhere unless a community was threatened, overruled any chance of action of fire SM33 at that time.
- There was concern in the Salt River Community about fire SM33 and the fact that no information on the danger to the settlement was sent by the Forest Service.

SM33 provides mute testimony to the eventual costs in terms of values lost and firefighting costs when fires are not discovered and attacked when very small. The fire consumed nearly one-fifth of all the mature timber in the Slave River valley. Damages were very conservatively estimated at \$400 000. Fire suppression action was a failure, yet cost over \$140 000.

4.4.4 Fire HY41 Pine Point

Fire Statistics HY41

Time reported	1542 Aug 14, 1979
Initial attack	1625 Aug 16, 1979
Size at initial attack	101-121 ha (250-300 ac.)
Size Day 1	405 ha (1,000 ac.)
Size at extinguishment	24 290 ha (60,020 ac.)
Time extinguishment	Sept 14 1979
Total costs	\$341 300

The Pine Point fire was reviewed by the Fire Panel because it was representative of large fire control action in Priority Zone 1 when life and property were threatened.

The fire history in the Pine Point area indicated that only four fires occurred over the past five years, burning an area of less than 20 ha (50 ac.) by forest fires three times since it came into being.

The Pine Point area is characterized by generally flat topography with gentle slopes. Areas of poorly drained muskeg alternate with low forested ridges. The major tree species present include jack pine, white spruce, black spruce, tamarack and trembling aspen. The black spruce fuel type together with sedges, mosses and cladonia lichen are the most flammable producing flames 10-12 m (33-40 ft.) in height above the trees. Pure stands of jack pine were totally consumed by intense fire. However when mixed with aspen the stands were only partially destroyed. There were few natural fire barriers to assist in fire control.

The resource values identified in the fire were life and property at Pine Point where the population approximated 1 800 persons and mine assets were estimated at \$30 million. A telephone line, a microwave site, railroad spur and highways were also values at risk. There were eight traplines with annual revenue amounting to about \$22 000.

The fire hazard at Pine Point was rated as high on August 14 and the Fire Weather Index was 20. At Fort Smith and Angus Lookout the hazard was extreme with fire weather indices of 37 and 39 respectively. It was later estimated that the Pine Point weather information was incorrect and that hazards were indeed extreme. Drought conditions were evident through the presence of dry ponds and dry stream courses.

The Angus Lookout in Wood Buffalo reported a smoke in the vicinity of Pine Point on August 10. Air patrols were made over the area after the report and again on August 11, 12 and 13 with no

Little Buffalo River

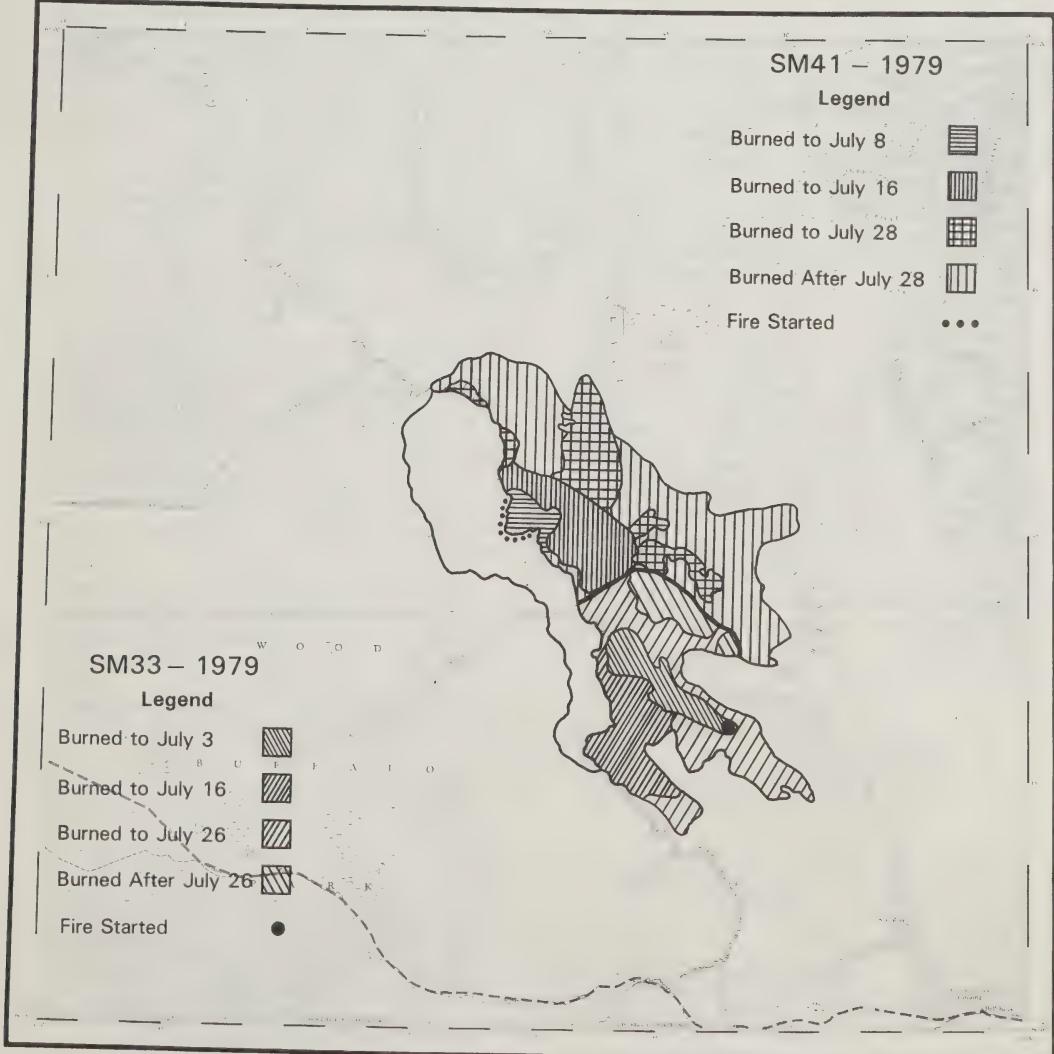


Figure 4.6: Fire area SM33 and SM41, Grand Detour.

fire seen. On August 14 smoke was reported by both a resident of Pine Point and the Angus fire Lookout. The report was received at 1542 hours. The fire location was approximately eight miles from the town.

The first initial attack included a three man crew which arrived at 1625 hours by helicopter from Hay River. Six additional crew members arrived later by truck from Hay River. A DC6 air tanker dropped retardant on the fire shortly after the arrival of the first ground crew. Two Canso aircraft also attacked the fire later on the first afternoon. The fire at initial attack was 100-120 ha (250-300 acres) and one hour later had spread to 200 ha (500 acres). Air tanker activities were stopped because the fire was too large for them to be effective. At 2145 hours on Day 1 the crown fire had reached 404 ha (1,000 acres) and was moving rapidly. The community of Pine Point was informed of the fire danger. Only twenty-nine men were on the fire line at this time.

Fifty to 60 men were on the fire lines on August 15 and 16. Three helicopters were available for transportation and two Cansos and one DC6 provided air tanker support. Switching winds on both days endangered crews and on the evening of August 16 all men were moved from the fire to the town of Pine Point and the fire was essentially abandoned.

The Forest Service planned to make a stand at the edge of the town should the uncontrolled fire advance. Townspeople and Forest Service constructed a major fire guard from which burning-out procedures could be initiated towards the fire. The preparation of the fire guard took place on August 17, 18, 19, and 20.

Rain and cooler weather on August 20 reduced the danger to the town and enabled the start of "mop-up" operations on the fire line. Additional rain on subsequent days ended the fire danger and fire action terminated on September 14.

Considerations

The Fire Review Panel recognizes that many decisions were made under stress and fatigue and without adequate resources to meet fire demands.

1. The size of the fire was large at time of discovery. The detection capability was poor in the general Pine Point area due to inadequate fire lookout facilities.
2. The Fire Weather Index was not correct for Pine Point resulting in minimal initial attack. (One helitack crew of three men.)
3. There was confusion as to the time the fire was reported. The Pine Point Emergency Committee indicated that the smoke from the fire was reported at 1430 hours to the Regional Fire Centre yet 1542 was the recorded time that the message was received at the Fort Smith office.
4. Firefighters, supervisors and pilots had been operating for two months without sufficient relief or rest and were in a state of fatigue.
5. There was insufficient manpower and overhead to develop an effective attack at first light on the second day of the fire.
6. Weather information was inadequate. No warning of wind change was available to fire crews which was a threat to life, and detrimental to morale.
7. The decision to protect the town by fire guard construction and removal of fuel by "burning out" points out the urgent need of reducing dangerous fire fuels around towns before an emergency situation develops.
8. The large manpower resource for firefighting in the town was not properly utilized even though required in days one and two of the fire. There is a need for pre-organization of firefighting resources on a continuous basis including training of supervisors and manpower in order to meet forest fire emergencies.
9. Only 60 men were available on the firelines during the critical days of August 15 and 16 and many of these were tired from overwork.

10. The citizens of the town of Pine Point were cooperative and well organized for community protection and evacuation if necessary.
11. In a brief submitted to the Fire Review Panel the Town of Pine Point asked:
 - a. Why did the forest fires become as large as they did to threaten the lives and property of the Town?
 - b. With the benefit of hindsight what can be done to prevent, to the best of our ability a reoccurrence of large threatening fires in the Pine Point area?
12. The Town also recommended:
 - a. Establishment of a fully equipped Forest Ranger Station at Pine Point
 - b. Establishment of "Priority Forest Fire Protection Zone" with a 15 mile radius from the town of Pine Point
 - c. Establishment of a manned forest fire lookout tower to give immediate warning of any fire starting.
13. A complaint was received from the HTA that crews were being flown daily between Hay River and the fire rather than stay at fire camp. On August 25 it was decided to locate the one remaining five man crew in Hay River rather than maintain a commissary and service function at the fire. The helicopter was needed to bucket water on the mop-up operation and flew back and forth daily between the fire and Hay River where maintenance facilities were located. Three of the men would fly with the helicopter and the remaining two returned by truck daily.

4.5 Fire SM38 — Tethul River

Fire Statistics SM38

Location	Priority Zone 1
Fire Cause	Lightning
Fire Discovered	2017 hrs. July 6, 1979
Fire Size at	35 ha (86.5 acres)
Discovery	
Fire Reported	2019 hrs. July 6, 1979
Fire Out	1800 hrs. July 9, 1979
Final Size	65 ha (160.6 acres)
Total Suppression	\$15,949
Cost	

The Panel reviewed fire SM38 because it was representative of control activity on many relatively small fires in Zone 1 during a period of extreme fire hazard. The Fire Weather Index was 34 and the Buildup Index was 71. The relative humidity was 31 and the wind 23 km/h (14 mph) from the southwest.

In the past ten years only two small fires occurred in the immediate area of the 1979 fire. The area was part of registered trapline 801.

The fuel type was meadow and shrubland, with isolated pockets of black spruce and hardwoods. The topography was flat with many natural fire barriers in the form of lakes, rivers and open meadows.

The only rapid access to the area was by helicopter. The fire was 34 km (21 miles) from Fort Smith and was discovered by a birddog aircraft fire detection patrol. There was no fixed detection capability but aircraft smoke patrols were made over the area at 1515 hours and 1715 hours on July 6. A patrol at 2017 hours on the same day located the fire. The fire had been burning for some time based on the 35 ha size at discovery. The fire was believed to be a "sleeper" from a lightning storm three days earlier.

The initial helicopter attack started at 2050 hours with an attack crew of two men and a fireboss. Three additional men arrived four minutes later in a second helicopter. Seven additional firefighters

were flown in within 45 minutes. The DC6 air tanker arrived 30 minutes after initial attack had started and dropped 2 500 gallons of retardant in order to control the western fire perimeter. Thirty minutes later an additional load was dropped by the air tanker consolidating 850 m (2,800 ft.) of fireguard on the western flank of the fire.

The 12 man firefighting force with assistance from the air tanker gained control of the fire at 2250 hours which was two hours after first attack. Mop-up of the fire continued throughout July 7 and 8 utilizing power pumps, the most effective control tool. The fire was declared "out" on July 9, 1979.

Considerations

The Fire Review Panel regarded the following points as significant.

1. The discovery of the fire at a size of 35 ha (86 ac.) was unsatisfactory and indicates the need of improved fire detection in the Fort Smith District.

Most fire agencies aim at discovery at a size of 0.1 ha ($\frac{1}{4}$ ac.) or less. A more realistic goal for the North might be 0.4 ha or 1 acre.

2. The fire boss and the crew appeared to be well organized and successfully controlled a fire which was relatively large at initial attack.

3. Although two helicopters were used and the distance to fire was short the first attack force to arrive was only two men and a crew boss. Three additional men arrived four minutes later.

The limited capacity of helicopters normally used on initial attack is a constraint to rapid control of small fires. Larger helicopters are less costly in the long run and can save money by transporting a larger initial attack crew and gaining control while fires are still manageable. Rapid removal of firefighters and equipment from the extinguished fire is also an asset.

4. The DC6 air tanker using long term retardant provided an essential support to the ground crews in the important early stage of fire attack. The long term retardant was successful in holding the fire except for two small escapes that were rapidly controlled.

The alternative to the use of air tankers would be massive initial attack by air which is not practicable because of limited air transportation facilities.

5. The continuation of mop-up until 3:00 a.m. on July 7 was a good decision. The total mop-up time was reasonable considering the fire size.
6. The fire was apparently judged to be out early in the morning of July 9 and for statistical purposes should have been declared out at that time rather than at 1800 hours, July 9.

Chapter 5 Functional Analysis and Recommendations

5.1 Forest Fire Detection

An alert and effective detection system is essential to a forest protection agency. Rapid detection of fire is particularly important in the Northwest Territories where distances are great and initial attack forces often have to travel 50 — 200 miles to attack a reported smoke. Under such circumstances, early discovery is critical to fire control effectiveness. The Pine Point and Grand Detour fires clearly exemplified the need of an effective detection system.

In the Northwest Territories the fixed fire detection system is still in the developmental stage. A major study and report on fire detection was made by the Canadian Forestry Service in 1975 (Niederleitner 1975). His work provides background information for the establishment of a major fire detection system utilizing fixed lookouts and aircraft patrols. Detection planning has also been conducted by Regional and District staff of the Forest Service. Implementation of plans has been very slow due to constraints of time and money.

There was a significant increase in fires discovered by Forest Service aircraft in 1979, as shown in Table 5.1, compared to previous years which is likely related to increased air patrols and the fact that aircraft are better than fixed lookouts when low visibility is caused by smoke.

Figure 5.1 indicates the location of the nine fire lookouts in the Northwest Territories of which five are located in the Fort Smith District, namely Tsu Lake, Long Island, Cameron, Hart Lake and Horn. The Angus lookout in Wood Buffalo National Park provides a limited coverage to the hazardous fuels of the Pine Point area. A new lookout is urgently needed in this locale. In 1979 only three of the five district lookouts were manned. Long Island lookout was not manned although it was built some years ago. Horn lookout was under reconstruction and not ready for operation in 1979.

Fort Smith Area Fire Lookouts

1979

	FIRES REPORTED	REMARKS
Tsu Lake	11	
Horn	0	Not Manned 1979
Hart Lake	4	
Cameron	12	
Long Island	0	Not Manned 1979
Angus (WBNP)	1	In Wood Buffalo Park
Pine Point	0	Planning stage
1979 Fires Reported	28	

The Fort Smith detection system utilized a combination of fixed lookouts and aircraft to discover and locate wildfires. Aircraft patrols were flexible and their use was increased or decreased according to the fire hazard and lightning forecasts. Fire statistics indicate that most smokes were discovered in the afternoon which is related to higher combustion rates at that time.

The chief disadvantage of detection by aircraft is that a relatively small area is visible at one time and fires can occur after the aircraft has passed. A mixture of fixed lookout and aircraft detection is a strongly recommended and effective approach, especially when the lookouts provide important additional benefits of telecommunication and fire weather information. It is also vitally important to continue to encourage cooperation from the public in the reporting of fires.

The smoke problem from many fires burning in the district seriously affected the capability of lookouts and aircraft patrol. In the 1979 fire season smoke from forest fires reduced visibility to 0-5 km (0-3 mi.) for 20 days, 5-8 km (3-5 mi.) for 10 days and 8-16 km (5-10 mi.) for 8 days. The normal distance for lookout visibility is 40 km (25 miles) and on a very clear day distances of 64 km (40

miles) are not unusual. No arrangements for the use of infrared detection of fires through smoke was made. This proved to be a serious shortcoming.

Infrared scanners are now in use by most fire agencies. The most common scanner is the AGA Thermovision 750 which is used to locate holdover fires in the spring, hot spots on going fires and in Alberta it is used for scanning where smoke prevents normal visibility. The Alberta Forest Service has developed an aircraft mounting for the AGA scanner at a cost of approximately \$2 500. The mounting provides a rocking motion to the scanner allowing a fire detection scan of about 5 km (3 miles) width at 3 048 m (10,000 ft.) altitude.

In 1979 the detection system was only partly effective because two lookouts were not operational and smoke from fire was a serious problem. It is important that infrared detection capability be improved in 1980 in order to locate fires through smoke cover.

Helicopter attack crews patrolling for reported lightning strikes could use the same equipment to advantage in the detection of "sleeper" fires.

One lightning detector which senses magnetic and electrical fields radiated by lightning was located in Fort Smith and it proved to be effective in indicating general locations of lightning strikes which could then be patrolled by the detection aircraft and accurately located. Alberta, British Columbia and Saskatchewan all have lightning detectors and coordinated information should be looked into.

In the Fort Smith District, detection aircraft normally have to be accounted for under the presuppression budget because the hiring of casual aircraft for improved detection is not considered a legitimate charge to the fire suppression budget. In the 1979 emergency year the hiring of detection aircraft was approved and it is recommended by the Panel that the policy be continued in future years.

5.2 Forest Fire Suppression

5.2.1 Manpower

In the 1979 Fort Smith fire suppression organization, there were seven permanent staff positions and 42 seasonal positions. The permanent staff consisted of one District Protection Officer, three Resource Management Officers and four Assistant Resource Management Officers assigned to the Caribou Range, Hay River and Fort Smith Sub-Districts. The seasonal positions consisted of six suppression crews, plus miscellaneous assistants such as lookout men, and radio operators. Two contracted 5-man suppression crews were also available in 1979 but funded from a separate source. The Forest Protection Officer acted as fire and resource coordinator between the three Sub-Districts. Resource Management Officers work part time on fire activities and have additional responsibilities in land and water use considerations.

One of the most serious problems in the 1979 fire emergency was the shortage of all types of trained manpower. There must be a strong skilled manpower source to meet normal fire year demands. In extreme periods and in extreme years the organization must have a capability for rapid expansion. No fire agency can afford to maintain a staff that will be on hand to meet extreme years but it must have sufficient trained supervisory staff to manage emergency manpower increases. It is also necessary to obtain assistance from the public sector and from other fire organizations. It is important and necessary to determine the levels of personnel that will be required and then proceed with a training program in order to teach them fire control principles. There is a need for additional professional and technical staff to meet new fire management challenges and responsibilities.

Table 5.1: Fire Detection
Fort Smith District 1970-1979

Fires By Discovery Agency

Agency	9 Year Total										%	1979	%
	1970	1971	1972	1973	1974	1975	1976	1977	1978				
Lookout	7	9	11	2	8	11	16	20	17	101	11.3	28	15.7
Forestry Ground	8	3	7	3	5	1	2	6	3	38	4.3	8	4.5
Forestry Air Patrol	48	55	37	87	8	22	33	34	20	344	38.7	120	67.0
Public Ground	16	29	13	18	13	9	12	30	22	162	18.7	14	7.8
Public Air Patrol	29	38	43	32	6	16	16	26	22	228	25.6	9	5.0
False	--	5	2	3	1	4	2	--	--	17	1.9	--	----
TOTAL	108	139	113	145	41	63	81	116	84	890	100.0	179	100.0

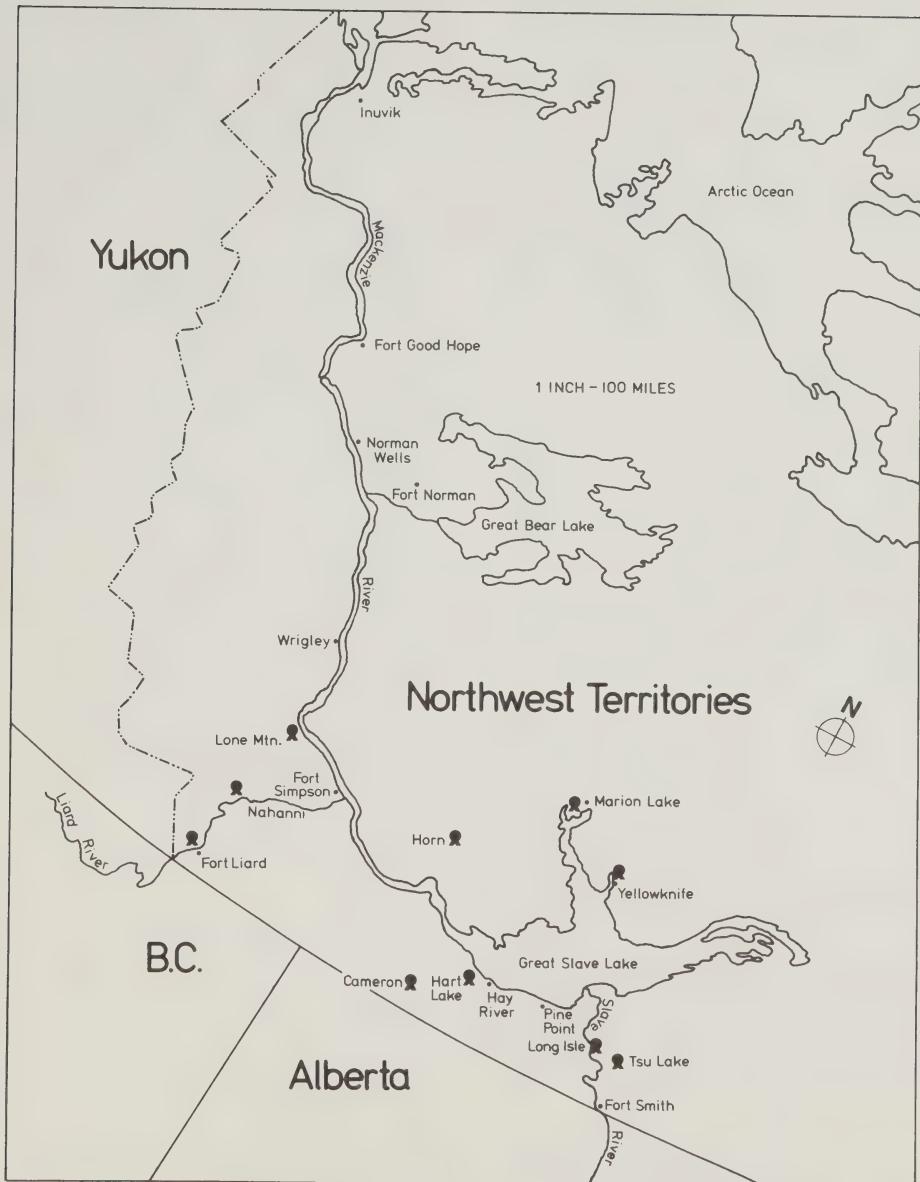


Figure 5.1: Lookout system 1979.

In order to obtain greater interest and participation by the native people in fire control activities it is important to develop an initial and sustained fire attack capability from within the communities. We recognize that encouragement, training and monitoring will be necessary. The use of local seasonal fire rangers with equipment on hand and the authority to hire local trained firefighters to action nearby fires is one possible approach. If distances to a fire are long and air transport required the local men should be flown to the fire rather than bringing a suppression crew from a different area.

5.2.2 Initial Attack Capability

The initial attack force at the start of the fire season consisted of six 5-man fire suppression crews, two helicopters and one DC6 air tanker with a lead aircraft. This force was increased based on the fire situation, and the availability of helicopters and air tankers from the public or other fire agencies. Initial attack crews were often placed at advanced bases away from Fort Smith and Hay River to provide more rapid attack on new fires.

Additional assistance was brought into the district as the fire hazard increased consisting of 4 suppression crews and 16 supervisory staff including 4 crew foremen. There were 309 emergency firefighters hired during the season on a casual basis. The control objective was to aggressively and rapidly attack all fires in Zone 1 and 2 as they were discovered and control them before 10:00 a.m. of the following day. Ten o'clock in the morning is not considered a significant fire time in the north because of the long days. A time later in the day should be adopted for use.

During extreme fire hazards, small lightning fires spread rapidly. The DC6 air tanker gave initial attack to 41 fires in the Fort Smith District before the arrival of the helicopter initial attack crews. The long term retardant drops were successful in gaining time for the follow up helicopter attack which in some extreme cases came 24 hours later.

The initial attack crews have five members each and with helicopters available, such as the Bell 206B and the Hughes 500D, it was possible to take only three persons plus equipment on initial attack. The small size of the first crew to the fire was a constraint to rapid control under extreme burning conditions. Larger helicopters such as the Bell 204B or the Bell 206 Long Ranger have the capacity to carry a complete crew plus equipment under favorable weather and fuel conditions. Rapid initial attack of forest fires when they are small and more subject to control is a basic and important fire-fighting maxim and provides the greatest saving at the lowest cost. The use of larger helicopters for transportation of initial attack crews should be a high priority.

Ninety-three fires occurred in Priority Zones 1 and 2 of the Fort Smith District. Eighty-seven of the fires were extinguished while they were still small and the total area burned was 296 ha (732 ac.). The total cost of suppressing the 87 fires was \$486 984 or an average of \$5 598 per fire.

Of the six remaining fires in Zone 1 and 2, four fires SM33, HY41, SM32 and SM41 did not meet detection standards because of poor visibility and became very large and costly. There were two fires that were not actioned because they were burning under controlled conditions on islands. The total area burned by the four fires receiving partial action amounted to 94 619 ha (233,808 ac.). The total cost of suppression was \$588 542. The cost of the large fires was approximately \$145 000 each.

Rapid detection and immediate initial attack are necessary on all fires while they are still small and can be controlled at relatively low cost. As fire hazards increase there is a need for more frequent aircraft detection patrols, more helicopter attack crews and additional retardant air tankers.

5.2.3 Large Fire Capability

In the Northwest Territories because of long distances, shortage of trained firefighters and low intensity of resource use it is not necessary or possible to utilize a large costly fire line organization on "project" or "campaign" fires. In lieu of manning up to "fire guard" around a large fire, the common practice is to attack only the threatening sections that can be safely and readily controlled at low cost. Burning out from creeks, lakes or a prepared fire line to create a fire guard is a well known practice, however, it was not generally successful on the Fort Smith fires due to lack of manpower and on the Grand Detour fire because of variable winds. No aerial ignition was used in any burning out operation in the Fort Smith District. The Panel considers aerial ignition techniques to be essential and the subject is addressed later in the report.

The Fort Smith District in 1979 had no suitable reserves for fighting large fires. In terms of manpower, a fire that requires 50+ men is considered large and under extreme hazards and without proper action could expand rapidly. The shortage of qualified manpower was in supervisory staff as well as in firefighters. Most of the extra firefighters had little or no training in recent years. The large Pine Point fire was managed by Forest Service personnel from other NWT districts and only the service function was provided by the Fort Smith staff.

A major constraint to large fire control is the logistic problem of moving men, equipment and supplies long distances and supplying the operation during the term of the fire. Helicopters were in short supply and were needed for initial attack on new fires. Air drops of supplies were not made in the district. The provision of fuel for aircraft is a major logistic problem when distances to fires are great.

When air tankers were used on large fires, the retardant drops were correctly made on specific danger points rather than wasting effort trying to hold long lengths of fire line by this method.

The Fort Smith District requires some large fire capability for an emergency year and should not have to rely completely on assistance from other areas. In addition to initial attack forces there should be an identified reserve manpower capability of some 48 firefighters, 12 crew foremen, 2 radio operators, 4 sector bosses, a service function and 2 senior fire specialists capable of handling all senior fire line positions. The two senior specialists and the service function should be Forest Service staff. All other positions could be native persons trained for the jobs and recruited in emergency periods to fight fire.

5.2.4 Preparedness

Preparedness is a basic essential to all fire management organizations for the combating of small and large fires. Preparedness or pre organization applies to all operations of a fire organization. Manpower, aircraft, detection, training, fire prevention, equipment and communications must all be ready to meet the demands of the fire season. In 1979 high fire occurrence and subsequent fire loads were beyond the capability of the Fort Smith staff to handle with their limited resources.

The greatest losses in area and dollars are related to disastrous fire years and since they recur with unpredictable frequency, it is imperative that pre organization for disaster years be an annual practice.

An aid to preparedness would be a complete list of the locations of all trappers cabins, mines, and lodges together with associated information such as communication, fire equipment on hand, fuels and fire hazard, and fuel management requirements.

It is essential that the Forest Service be prepared for unpredictable above average fire years. A fire agency must have the capability and flexibility to expand its firefighting resources on short notice to meet heavy fire loads. Although exchange of manpower, aircraft and

equipment can be pre-arranged with other forest protection agencies it is necessary to have a well trained and experienced fire supervisor hierarchy to direct and effectively absorb an influx of men and materials. All information must be detailed and kept up to date as a fire disaster plan.

5.2.5 Fire Prevention

In the Fort Smith District over a ten year period, 65% of all fires were started by lightning. In 1979 it is estimated that 80% of the fires were caused by lightning. With the present state of technology there is no practicable way to prevent lightning. However, man-caused fires can be prevented.

Man-caused fires average 20% of all fires that occur in the district and point out the need of new and sustained efforts in fire prevention. Seventy-two percent of all man-caused fires in 1979 were from campfires of recreationists and trappers.

A high priority should be given to the prevention of man-caused fires because it can be productive in terms of fire reduction and forest resource values saved in relation to program cost.

The Alberta Forest Service fire prevention manual has been adopted by the Northwest Territories as a basis for planning and prevention program development. Each district is responsible for developing its own prevention campaign based on local man-caused fire problems. The Fort Smith District prevention plan developed in 1978 is very general. It recognizes the need for contact with the forest user and the general public in order to provide education and information. It provides for posters and suggests meetings with Hunters and Trappers Associations, school children and other groups.

There does not appear to have been a careful analysis of all man-caused fires followed by the establishment of specific prevention goals and problem related action plans. Such a plan must have cost and time inputs and evaluation criteria in order to determine if the prevention goals are being met.

A general fire prevention program is reasonable if the objective is to inform or educate the public. However to reduce the number of man-caused fires it is essential that relevant fire causes and locations

be identified and a dedicated and direct personal approach be made to the actual people that are starting the fires.

The fire prevention program of the Northwest Territories lost credibility with the public when uncontrolled fires were seen to be burning with little or no suppressive action in Priority Zones 3, 4 and parts of Zone 2. The inference was "why tell us how to prevent and to report fires if they are not going to be fought".

5.2.6 Administration

The Fort Smith District and the Regional Fire Centre provided valuable statistics and material that were presented during the public hearings in December 1979. All staff were very cooperative and provided additional information whenever it was requested. Some excellent summary forms are in use that provide statistics on specific subjects. For example all personnel received a daily suppression report and a presuppression report outlining the availability and location of all firefighting resources. There is a need for an annual fire report for the Fort Smith District year that will amalgamate the many sub-reports and information. The Wood Buffalo National Park has a very good annual report that could be used as a model.

During an emergency when personnel are overworked, the completion of accurate records can readily be overlooked. However, the information is vital for later study. The use of aids such as fire line notebooks should be encouraged.

The wildfire report form is complicated and a great deal of detail is needed to complete the input for computer storage. In the long term the information stored will be valuable for analysis and organizational improvement if the data are accurately recorded in the first instance.

During the fire season many fires burned together and ended as one fire, e.g. SM2 was an amalgamation of 12 fires. The practice was to declare a fire extinguished when it amalgamated with another and at the same time to transfer the area and cost information over to the new amalgamated fire number. This created statistical problems for the following reasons.

1. Area and cost figures were not recorded on the report form of

**Table 5.2: Fort Smith District
Fires by Source of Ignition**

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	TOTAL	%
Lightning	86	91	63	104	17	45	58	39	47	143	693	64.8
Camp Fires	12	31	24	29	16	11	6	39	21	26	215	20.1
Industry	1	4	1	2	3	--	4	4	4	--	23	2.2
Trash	--	--	--	1	3	--	1	3	4	2	14	1.3
Smokers	3	1	1	--	--	--	--	16	2	--	23	2.2
Incendiary	1	1	--	--	--	--	1	2	1	--	6	.6
Misc. Known	2	--	3	3	--	2	2	7	3	8	30	2.8
Unknown	3	6	19	3	1	1	7	6	2	--	48	4.5
False	--	5	2	3	1	4	2	--	--	--	17	1.5
Total:	108	139	113	145	41	63	81	116	84	179	1069	100.0

the fire that lost its identity in the amalgamated fire.

2. In some cases due to error the area statistic from one fire was not transferred to the amalgamated fire. This could cause duplication in estimate of area burned.
3. The original fire SM2 was in Zone 3 but many of the associated fires were from Zone 4. The amalgamated statistics became related to Zone 3 only.
4. The assumption that a fire is extinguished on amalgamation with another fire can result in incorrect statistics as to the hour the fire was controlled and the size class on extinguishment.

The burning together and amalgamation of 12 fires to form fire SM2 was unusual. When fires unite the lowest fire number should be maintained and for record purposes it will absorb the statistics of the component fires before and after amalgamation. For fire reviews and studies a summary of the statistics up to the time of join-up should be recorded in the remarks section of the wildfire report form together with an explanation of events.

The following shortcomings in records and plans were noted:

1. The fire management plan was in the developmental stage only.
2. The daily fire situation report telex was not consistent in accuracy and information. A daily summary of new fires, fires out and fires still burning would be helpful.
3. Green areas left within large fire boundaries are not normally deducted from total fire area.
4. Some information sheets show that two fires were fought in Zone 4, Caribou Range sub-district, however this does not appear on statistical summaries of fires by Zone.

In summary many of the plans, records, maps, fire reports, statistics and history of past and current developments viewed by the Panel were lacking in continuity, clarity and accuracy. Accurate and up-to-date information on well organized records is necessary input into effective fire management planning and for uniform and accurate performance evaluation on each aspect of a fire control operation. A review of administrative records is needed.

5.2.7 Training

A comprehensive and expanded fire control training program is urgently needed in the Northwest Territories in order to fulfill requirements for improved fire management. All levels of manpower when appropriately trained can perform their fire tasks more effectively.

The planning, organization and implementation of the Northwest Territories fire training program is the responsibility of the Training and Standards Officer located at the Regional Fire Centre. His workload includes establishment of standards for the fire program and specifications for the purchase of equipment and materials.

At a fire management meeting in 1977 the training needs for the Northwest Territories were outlined. Deficiencies in staff knowledge were noted in fire behaviour, fire prevention, safety aircraft management, and supervisory skills. The need to train and certify all personnel for specific fire jobs was recognized but has not yet been implemented. Although the fire training plan has not been fully developed or formalized two concepts have emerged.

1. Districts will be responsible for the training of fire suppression crews and other community firefighters.
2. The Regional Fire Centre will develop and manage training programs for all supervisory personnel starting at the crew boss level.

Training programs in the past two years were well intentioned but have not met the defined needs of the fire program. Firefighter training courses in 1979 for the Northwest Territories accommodated only fire suppression crews plus 10 potential firefighters in Yellow-

knife. There were no recorded firefighter certification programs for native people other than those in suppression crews. The training courses for supervisory fire line positions appear to be general rather than specific. Some outside training has been accomplished by sending people to courses in Alberta and the United States. However, progress has been limited. Such training is necessary and needs to be augmented for specific fire positions.

The Panel considers the following viewpoints to be important in the development and implementation of an expanded fire training program.

1. An expanded program of training and certification for firefighters and supervisors is essential to meet the goal of improved fire management. This should be developed into a plan for application to full-time staff, seasonal and casual help.
2. The workload involved in managing an effective program for the Northwest Territories within reasonable time limits is too great for one person. A full-time training officer position is needed immediately in the Regional Fire Centre. A native northerner will be needed later at the Regional Fire Centre to coordinate native training and improve communications with native groups throughout the Northwest Territories.
3. A standard training outline for firefighter training in all districts is necessary in order to facilitate exchange of firefighters between districts. Community leaders should be consulted about training needs within their communities, and courses modified where possible to meet them. Skilled local people should be enlisted to assist with instruction to teach local techniques.
4. The staff of the Northwest Territories, the Yukon Territory and the National Parks need to discuss mutual training requirements and plan a cooperative approach to appropriate fire training programs.
5. Fire experience is an essential adjunct to training and must be a requirement for each new level of training achieved.
6. Supervisory fire training courses must be directed to providing skilled certified personnel capable of manning specific positions in the hierarchy of fire overhead positions. The most appropriate time for supervisory training especially for Resource and Assistant Resource Management Officers is during the months of January, February and March.
7. The ability of the crew boss is the key factor for initial attack success on forest fires. A top priority must be accorded to the selection and training of men from suppression crews and from local communities. It is important that the training be conducted in a fire environment if possible.
8. Valuable and practicable knowledge for fire control personnel can be obtained on training courses outside of the Northwest Territories and on study trips to other fire agencies.

In the Fort Smith District there was a lack of trained firefighters in 1979. Training and certification of firefighters has been limited to suppression crew members. An inventory of manpower needs and availability is required followed by a planned program of training and certification in native communities.

5.2.8 Fire Weather

Fire weather stations are essential for the provision of data for fire weather forecasts and for fire danger ratings of the Canadian Fire Weather Index. Adequate weather data input helps the fire manager to anticipate critical conditions that could promote the rapid spread of forest fire.

There are only 10 permanent weather stations and 18 seasonal weather stations in the Northwest Territories. Some permanent stations do not take weather information on weekends which from the

Forest Service viewpoint seriously reduces effectiveness. Studies carried out in 1979 by the Atmospheric Environment Service (Forbes and Kotylak 1979) include recommendations to form a more complete network. The use of automatic remote controlled weather stations can be cost effective in inaccessible unpopulated locations. Several agencies desire an improved data source from such areas. Coordination in planning, construction and cost sharing of new stations should be possible. In addition to the Forest Service there should be interest by the Atmospheric Environmental Service, the Water Survey of Canada of the Department of the Environment and the Water Resources Division of the Department of Indian Affairs and Northern Development.

The Panel believes that without an expanded fire weather network the effectiveness of the fire organization will be curtailed. It is also necessary that weekend readings be reported from Ministry of Transport weather stations. Recommendations will be included in Part III of this report.

More information is needed on how long term weather factors create periodic or cyclic drought conditions. If fire agencies could identify significant factors prior to the fire season they could be better prepared to meet heavy fire loads associated with dessicated forest fuels. Some statistics on water levels and snow packs of the year 1978 were studied by the Panel, however, no significant trends were noted that pointed to 1979 as a drought year.

Practical studies should be continued annually by the Forest Service into such factors as snow pack levels, water levels in small streams, spring foliage moisture indicators and ground water levels.

Chapter 6 Operational Implications of Policy

6.1 Introduction

At the Fort Smith public hearings, the Priority Zone Policy was frequently and strongly criticized by hunters and trappers. Native communities in the Fort Smith District were unanimous in the condemnation of the policy with particular concern over lack of protection of resources in Priority Zone 3.

The Priority Zone policy of the district is the same as the rest of the Northwest Territories although each district has a different area and pattern of protection. See Figure 3.1 District and Protection Priority Zones.

6.2 Priority Zone Policy

6.2.1 Priority Zoning

Priority Zone 1 is assigned to the protection of lives and property associated with communities. In the Fort Smith District the principal population centres of over 25 people are Fort Smith, Hay River, Pine Point, Fort Resolution, Snowdrift and Fort Providence. Priority Zone 1 in the Fort Smith District totals 13 277 sq. km (5,107 sq. mi.) and provides protected zones around communities. Rapid initial attack and sustained action to the limit of resources is practiced in this zone. Traplines, cabins, fishing lodges and other values that are within the limits of Priority Zone 1 will receive more protection than if they were located in Priority Zones 2, 3, or 4.

Priority Zone 2 is protected for communities of less than 25 persons, transmission and communication lines, mines, cabins and productive timber stands. Priority Zone 2 receives full initial attack with necessary follow-up action to gain fire control. If the fire load in Priority Zone 1 and Priority Zone 2 exceeds the capability of the suppression forces, priority is given to Zone 1 values. Threats to human life receive the highest priority in any zone.

Priority Zone 3 resource value criteria are the protection of high value habitat, significant aesthetic values, high erosion potential areas, valuable watershed areas, trapping areas and high quality but inaccessible mature timber sites. The policy since 1976 was that Priority Zone 3 would not receive action except for protection of life, cabins and lodges if threatened by imminent fire or if fires in Priority Zone 3 threatened resources in Priority Zone 1 or Priority Zone 2.

The Hunters and Trappers Association saw small fires in Priority Zone 3 that could have been extinguished become large and eventually threatened values in Priority Zones 1 and 2. The lack of flexibility in the suppression organization that prevented the Forest Service from attacking small fires in Priority Zone 3 was frustrating and unbelievable to the Hunters and Trappers Association, especially when there appeared to be standby crews doing little, and eager to work. Approximately $\frac{2}{3}$ of the traplines in the Fort Smith District are located in Priority Zone 3; the remaining one third are in Priority Zones 1 and 2 where they are protected. Priority Zones 3 and 4 in many cases are adjacent to Priority Zones 1 and 2 and uncontrolled wildfires can move rapidly into the higher Priority Zones. Under such circumstances policy dictates that suppression action be taken and it is usually difficult and costly because of the large fire size by that time.

Priority Zone 4 is listed as a non-production area and fires are monitored but not suppressed unless human life, property or higher Priority Zones are threatened. The suppression of fires in parts of Priority Zone 4 to protect the caribou winter range was called for by the Hunters and Trappers Association and was concurred with by all native communities visited by the panel. Caribou meat has traditionally been a vital food supply to the native population.

The implementation of the fire policy proved inadequate in 1979 because of an accumulation of weaknesses as a consequence of incremental constraints over the last few years. There was no

meaningful protection in Priority Zone 3, inadequate protection in Priority Zone 2 and adequate protection in Priority Zone 1.

The Fire Review Panel asserts that fire policy must define the resource values and areas that can be justified for protection. Once the protection area is agreed upon adequate funding is essential to provide an acceptable standard of firefighting resources to the protection agency.

6.2.2 Adherence to Policy

The terms of reference of the Fire Review Panel asked for identification and recommendations concerning difficulties or shortcomings experienced by the Fort Smith staff in adhering to fire management policy in conjunction with existing Priority Zone criteria, objectives and action guidelines.

Under the current fire policy when the fire suppression capability cannot meet fire load demands, the problem is solved by withdrawing and providing protection to life and property values only. The effect in the Fort Smith District was the removal of protection from all resource values listed in the Priority Zone criteria with the exception of life and property. Such a situation would be unlikely in a low danger fire year but inevitably serious fire years do recur. Values that receive costly protection during normal years can be destroyed if abandoned during serious years. An example is the loss of a valuable timber resource of 42 million board feet at the Grand Detour fires in Priority Zone 2.

Fire actions of the staff during the fire season were in general adherence to the fire management policy. However, monetary constraints lead to a decision to effectively withdraw protection from Priority Zone 3 before the fire season began, except for protection of life and threats to higher zones. This pre-season decision was not in accord with the stated policy of the Department.

The Priority Zone policy provided the following difficulties during the 1979 fire season:

1. It was often difficult for a lookout man or an aircraft observer to determine in which Priority Zone a new fire was located because of the lack of distinctive boundaries between Zones.
2. Initial attack action sometimes was taken on fires in Priority Zone 3 because of not knowing precisely where the boundary was located.
3. It was reported to the Panel that a helicopter attack crew was dispatched to a small fire thought to be in Priority Zone 2. The fire was eight acres in size and found to be just within the Priority Zone 3 area. Because of policy restriction returned to base and the fire grew to 3 035 ha (7,500 ac.).
4. It was reported that suppression crew morale was low because they were forced to stay on standby and not permitted to fight fires in Priority Zone 3 when no fires were occurring in Priority Zones 1 and 2. Some communities also objected to suppression crews on standby, playing cards while the country was burning up.
5. The criteria for resource value protection used as a basis for implementing fire policy in Priority Zones 2 and 3 are listed in the fire policy manual. The resource values listed in the criteria other than life and property were not protected in the Fort Smith District in 1979.
6. The objectives for Priority Zones 3 and 4 have lost all significance due to the overriding policy of no initial attack in the zones.
7. The action guidelines indicate that initial attack may be taken in Priority Zones 3 and 4 up to a limit of \$8 000 and \$3 000 respectively. However there is a separate overruling policy that does not permit any expenditure in Priority Zones 3 and 4 without approval from the Regional Fire Centre. The other fact is that since 1977 Priority Zone 3 has been administered as a non protection area.

6.3 Initial Attack Related to Fire Policy

The fire management policy is self defeating in its present form. When fire overloads occur and the firefighting resources are near exhaustion the policy reduces the protected area to meet the existing firefighting capability. In 1979 in the Fort Smith District large fires burning in Priority Zones 2 and 3 were not actioned initially thus losing the benefit of protection accorded to the areas in the previous decade. It is important to have a flexible suppression organization that can be expanded in drought years to provide greater initial attack capability on the increased number of forest fires that occur.

Fire policy dictated against initial attack on fires in Zones 3 because action was permitted only when life or property was imminently threatened or resources in Zones 1 and 2 were threatened. It is extremely difficult to predetermine what a small fire will do because of variables involved. In Zone 3 many fires were not judged to be a threat and were therefore not attacked when small. Fires SM22, SM26, SM28, SM46 and SM69 became large and threatened resources in Priority Zones 1 and 2 with resulting partial control firefighting costs of over \$700 000 and an area loss of 66,105 ha (163,345 ac.). The average suppression cost of each fire was over \$140 000 and the average size was 13 221 ha (32,669 ac.).

Nine fires, numbers SM42, SM12, SM54, SM55, SM59, SM60, SM61, HY33, HY36 in Priority Zone 3 received initial attack at small size. The initial attack was made either because higher priority zones were threatened or because the fires were thought to be located in Priority Zones 1 and 2. The nine fires cost \$48 252 to extinguish with an area loss of 20.4 ha (50.4 ac.). The average suppression cost was \$5 361 and the average size was 2.3 ha (5.7 ac.).

In the opinion of the Panel a policy of initial attack on small Priority Zone 3 fires would have been a less costly approach to the fire problem.

Chapter 7 Information Dissemination

7.1 Introduction

The Fire Review Panel was requested to evaluate the accuracy of the information provided by the Northern Affairs Program staff to the Minister and the public.

The confrontation between the Northern Affairs Program staff and the Hunters and Trappers Association reflected the great concern of the trappers. The Association perceived the large uncontrolled fires burning in Priority Zones 3 and 4 as a direct threat to their livelihood and their way of life. They considered the fire situation a disaster and were frustrated by the lack of action taken by government staff. For the hunters and trappers affected, the situation was a disaster. Even for those not affected directly it had disastrous implications by demonstrating what would happen in other areas without a fundamental policy change.

The Forest Service on the other hand recognized a severe fire season but did not consider the many large fires burning in Priority Zones 3 and 4 as a disaster because of the fire policy predetermined for the areas. "The primary aim in Zone 4 is to minimize firefighting operations thereby allowing ecosystems to continue to develop naturally." The fires in Priority Zone 3 were considered a problem by government staff only when large uncontrolled fires become a threat to resource values in the higher Priority Zones 1 and 2.

The difference in viewpoint caused a breakdown in communications between the Association and the Forest Service and as a result the news media became a national sounding board for a series of bitter and conflicting reports.

7.2 Preseason Communications

The majority of the communities visited by the Panel, throughout the Northwest Territories reported that they did not see "forestry" people very often. They requested an opportunity for input into fire policy. Most communities understood that the present fire policy did not include protection for traplines or the caribou range in Priority Zones 3 and 4. However such was not apparently the case with the Fort Smith Hunters and Trappers Association.

Forest Service staff at a meeting held in Fort Smith in July 1978 did explain fire policy to some members of the Hunters and Trappers Association and to community representatives. The objective of the meeting was to obtain support for an increased fire-fighting budget and a policy to protect traplines in Priority Zone 3.

In the past it was common practice to use native foremen and fire crews hired from the communities for initial attack on local fires. Today there are permanent suppression crews which are commonly moved in by aircraft to control local fires. The communities because of lesser overall involvement appear to have lost heart in fire matters and have less communication with the Forest Service.

There has been a high turn over of Forest Service staff in the past decade compared to Provincial organizations. The native community appears to view this as a lack of interest and dedication and relates it to Government employees in general.

7.3 1979 Fire Season Communications

The accusations against the Forest Service by the Hunters and Trappers Association were strong and numerous. Some of the major complaints relating to administration and communication were:

1. Misinformation to the Minister and the public as to number, size and severity of fires burning.
2. Incompetence and inefficiency of staff.
3. Overuse of aircraft from the south rather than using local native manpower.

4. Accountability on a continuing basis of those responsible for forest protection.
5. Crews sitting around doing nothing.
6. Information not getting through to the Minister.
7. The need for documentation of mismanagement or poor administration.

The Panel appointed a consulting firm to conduct a satellite imagery study of fire areas burned east of Fort Smith (Intera 1979). The large fire SM2 plus fires SM26 and SM28 were estimated by the company to have burned 723 556 ha (1,787,945 ac.) up to September 12. The Forest Service had independently estimated in late August that the same three fires had burned a larger area of 753 598 ha (1,862,182 ac.). Based on the above statistics the Forest Service did not appear to have understated fire sizes.

After studying background information the Panel considered that the numbers, size and severity of fires reported to the Public and to the Minister were basically accurate.

The Panel believes that there were inefficiencies during the emergency when fires were numerous and large numbers of men were recruited into the fire organization. Firefighters and some fire supervisors did not have the training and experience required to always do a satisfactory job. In a normal fire year there would have been sufficient qualified men available to do a better job.

Aircraft were essential for the transportation of men and equipment to remote fires where there were no roads for ground access available. The Panel is of the opinion that more local manpower should be used in the future. However, in most cases aircraft transportation will be essential for them. In 1979 the large DC6 air tanker helped materially in the control of small fires.

The Panel concurs with the Hunters and Trappers Association that there should be accountability on a continuing basis by those responsible for forest protection. Documentation of procedures and actions should be openly available to the public.

Standby suppression crews near communities were characterized as sitting around and doing nothing while the forests burned. Two points must be considered here. In fire control organizations it is imperative that experienced crews be available to take initial attack on new fires. It is standard practise in fire agencies that after initial attack the most experienced crews be returned to standby for a possible new fire. The other possibility presented was that on going fires there were crews sitting around doing nothing. Such statements can only be considered to be hearsay unless an investigation proves otherwise. The Panel was not present at the time that the fires were burning and cannot therefore prove or disprove such statements.

The way in which the fire policy was applied left Priority Zones 3 and 4 as virtually non-protected areas. The fact that many fires in these zones went unactioned while suppression crews remained on standby was a major source of aggravation.

Letters, telex messages and reports sent by the Northern Affairs Program were reviewed by the Panel. It was apparent that detailed information was sent regularly from the Northwest Territories to the Department in Ottawa. Facts were presented. It is difficult to assess whether or not the implications of those facts were also passed on. How much detail that was subsequently passed on to the Minister is not known.

The Panel concurs that mismanagement or poor administration should be recognized. It asserts that all fire procedures and actions should be precisely documented in order that faults can be identified and corrected.

In addition to the above there were over 100 comments, complaints and questions relative to firefighting procedures and policy together with answers from the fire agency which are compiled as an Exhibit.

Details on the fire situation in the Fort Smith District were accu-

mulated daily by the Forest Service and were available to the public and the news media on request. As the fire situation worsened the news media, native leaders, and the community were informed of the existing and developing fire situation.

On July 28 Peter Ferguson was appointed by the Minister to liaise between the citizens of Fort Smith and the forestry office and to inform the Minister and all parties concerned about current fire situations. Mr. Ferguson made fire information available to all on a regular basis including two special reports at public meetings on August 1 and August 21. The mayor and council were kept informed of the fire situation on a daily basis. Reports were also available for the Hunters and Trappers Association and the public.

The Forest Service provided a daily situation fire report by telex to Ottawa followed by weekly summaries including cost estimates.

In a major fire situation such as was experienced in 1979 in the Fort Smith area there is often a lack of detail, and delays in obtaining accurate fire intelligence. Long hours of work for the involved staff with accompanying stress and fatigue further compounded the situation.

Although the Fire Review Panel did find small variations in fire statistics there was no evidence of any attempt by the Forest Service to deliberately misrepresent or misinterpret the status of the fire situation. The Panel was not appointed until after the fire season ended and in order to resolve accusations of incompetence and mismanagement on fires it would have been necessary to investigate the specific fire situations as they occurred.

Chapter 8 Recommendation for Fire Operations in the Fort Smith District

8.1 The Problem in Review

During the months of June, July and August 1979 in the Fort Smith District 179 forest fires burned 1 402 950 ha (3,466,700 ac.) of forest land. The number of fires and area burned were the greatest in the recorded history of the district and the impact on the environment and northern residents was severe.

There was great and sincere concern expressed by the people of the North about the destruction of vast areas of forest on which many depended for trapping, hunting and a traditional way of life. The Forest Service of the Northern Affairs Program was strongly criticized for failure to provide adequate protection to the resource values at risk.

8.2 Mandate in Review

The Fire Review Panel was appointed by the Minister of Indian and Northern Affairs on November 1, 1979 as a result of representations made by the Fort Smith Hunters and Trappers Association and others. The Panel was asked to review the fire operations of the 1979 fire season in the vicinity of Fort Smith and to examine and assess the efficiency of operations, adherence to fire management policy and dissemination of information of the Northern Affairs Program.

8.3 Introduction

Fire management agencies recognize that under the stress of emergency fire situations, errors and poor decisions do occur. Training and fire experience help to minimize such problems. The Fire Review Panel believes that many of the criticisms levelled at the fire agency were a result of the concern and frustration of seeing large fires burning out of control in Priority Zones 2, 3 and 4 with no significant control being attempted by the Forest Service. The shortcomings of the fire agency were predominantly related to an unpopular fire policy, limited fire staff, shortage of aircraft and presuppression budget constraints. A reasonable job of fire control was accomplished in consideration of the extreme fire hazard and these constraints. Efficiency was reduced by fatigue and the shortage of qualified fire specialists, trained firefighters, and air transportation. The fire suppression personnel were dedicated to their jobs and worked long and hard under trying and tiring situations to meet a continuing series of fire overloads.

Recommendations for improved efficiency are incorporated with the many headings involved with fire control and fire management. The recommendations will be made by subject matter and in order of priority although all are important. Some recommendations are applicable to the entire Northwest Territories and have therefore been transferred to or repeated in Part III of this report.

8.4 Fire Management Policy

At the public hearings in Fort Smith and other district communities the strongest and most consistent complaint was in reference to the Fire Management Policy and its failure to provide adequate protection to Priority Zone 3 in particular. A major fault with the Priority Zone policy is that the protected area fluctuates annually with the severity of the fire season and the level of the presuppression budget. In 1979 it was decided before the fire season started that Zone 3 would be non-protected as discussed earlier. As a result Priority Zone 3 became a essentially non-protected area. Priority Zone 2 because of shortage of firefighting resources became a partially protected area. Priority Zone 1 received adequate protection because the firefighting resources were concentrated and the Forest Service was able to control most fires on initial attack, with some exceptions such as the large Pine Point fire.

In 1979 Priority Zone 3 was treated largely as a non-protection area and as a result fires became large and threatened resource values in Priority Zones 1 and 2. The necessary attack on these large fires was more costly than would have been the case with a minimal initial attack capability at the start of the fire season in Priority Zone 3.

The Fire Review Panel asserts that fire policy must define the resource values and areas that can be justified for protection. Once the protection area is agreed upon adequate funding is essential to provide a standard level of firefighting resources to the protection agency.

Recommendation 1:

In order to provide improved resource protection an initial attack capability must be used on small fires in trapping areas (Priority Zone 3) of the Fort Smith District in 1980 as an interim measure until land managers can define their requirements for resource protection. (See also Recommendation 29)

Recommendation 2:

Top priority needs to be given in 1980 to the review, study and revision of fire management policy alternatives with the objective of definition and implementation of an approved strategy in 1981. (See also Recommendation 26)

Recommendation 3:

In order to assure improvements in the fire management program for 1980 it is essential that supplementary funding be provided to the capital and presuppression budgets. Additional funds are necessary to amend known deficiencies in fire detection, training, planning, staffing and increased costs of aircraft. An adequate level of initial attack capability for Priority Zones 1 and 2 and an interim minimal initial attack capability for Priority Zone 3 cannot be managed without increased financial support.

8.5 Accuracy of Information

The Fire Review Panel was specifically requested to evaluate the accuracy of the information provided by the Northern Affairs Program staff to the Minister and the public. The Hunters and Trappers claimed that there was misinformation as to the numbers, size and severity of fire burning in early August.

In order to ensure that the public and the Minister received factual information a fire liaison officer (P. Ferguson) was appointed on July 28, 1979. In his report Mr. Ferguson pointed out that he checked the quality and quantity of information at the District and the Regional Fire Centre and the situation reports sent daily to Ottawa. He stated that the reports were straightforward and gave no indication of misinformation.

The Panel studied statistics, fire reports, maps, records and files at the Regional Fire Centre and at the District Office. There were gaps in information, errors in records and conflicting statistics, however, all were of a minor nature and there was no evidence of any attempt to deliberately misrepresent or misinterpret the 1979 fire situation to the public or to the Minister.

Recommendation 4:

The Hunters and Trappers Association should be given the opportunity to review all records of the fire season in order to clarify and resolve their concerns as to accuracy of information.

8.6 Public Relations

A confrontation between the Northern Affairs Program staff and the Hunters and Trappers Association occurred early in the fire season and an atmosphere of distrust is still present. The Association perceived the large uncontrolled fires in Zones 3 and 4 as a direct and serious threat to the forest, to their livelihood and to their way of life. They were concerned and frustrated with the failure of the Forest Service to action the Zone 3 and Zone 4 fires. The Forest Service reaction was that fire policy dictated what they could and could not do as far as fire suppression action was concerned. Therefore fires would only be fought in Zones 3 and 4 if they threatened resources in Zones 1 and 2 or if life or property were in imminent danger. The difference in viewpoint caused a breakdown in communications and as a result the news media became a national sounding board for a series of bitter and conflicting statements.

Recommendation 5:

Regular meetings must be encouraged between the Hunters and Trappers Association and the Northern Affairs Program staff commencing in 1980 with the objective of fostering mutual understanding and cooperation through improved communications.

Recommendation 6:

The Northern Affairs Program must initiate improved communication with all resource users and the public on a continuing basis in order to receive input and to establish and maintain a credible fire management policy.

Recommendation 7:

The Fort Smith District should broaden the communication base with their various publics by carefully and frequently explaining objectives, policies, responsibilities, work plans and constraints and by listening to expressed concerns.

8.7 Pine Point Considerations

The Panel believes that the town of Pine Point warrants specific consideration. The town has been threatened by forest fires three times since its establishment. It is the fifth largest population centre in the Northwest Territories and is located amongst hazardous forest fuels. The community has strong manpower and transportation resources available for fighting local forest fires. Increased fire control preparedness is required as soon as possible to reduce the risks of a fire disaster to the town.

Recommendation 8:

- a. A seasonal fire ranger should be stationed at Pine Point during the fire season.
- b. A small warehouse with firefighting equipment for 25 men should be located in the town.
- c. High priority should be given to the preparation and implementation of a fuel management plan for the environs of the town.
- d. The construction of the fire detection lookout which is already planned for the Pine Point area should proceed without delay.
- e. A comprehensive cooperative fire control plan should be negotiated in 1980 between the Forest Service, the town of Pine Point and Pine Point Mines.

8.8 Efficiency of Operations

8.8.1 Fire Detection

One of the most important concepts in fire control is the rapid discovery of new fires followed by immediate initial attack in sufficient strength to control or extinguish the fires when they are still small.

The detection system of the Fort Smith District is not able with its present strength and condition to discover new fires in the forest protection area within acceptable time limits. Only three of five fire lookouts were in operation during the 1979 fire season. The aircraft fire reporting system relied upon a variety of casual aircraft, a birddog aircraft and helicopters with attack crews for some lightning forecast areas. Infrared devices were not used on aircraft detection patrols over completely smoked-in areas such as the Grand Detour fire.

Recommendation 9:

The five existing lookouts in the Fort Smith District must be placed in operating condition for the 1980 fire season.

Recommendation 10:

In 1980 top priority needs to be given to the establishment of a lookout in the highly volatile Pine Point fuel area.

Recommendation 11:

It is important that a policy manual be prepared for the detection system including fixed and aerial detection procedures in relation to values-at-risk.

Recommendation 12:

A direct radio link should be established between Angus lookout in Wood Buffalo National Park and the Fort Smith District in order to expedite transmission of fire detection information.

8.8.2 Training and Manpower

The shortage of qualified manpower available for firefighting in the Fort Smith District was a serious constraint during the emergency fire year of 1979. Native communities advised that their interest in fighting local fires has decreased because seasonal suppression crews now have that responsibility and are being well paid for it. Firefighting pay would provide a badly needed cash flow into the communities. There is a need to strengthen the fire organization through an increased level of expertise in fire management and training. The planning and organization of the fire training program is the responsibility of the Training and Standard Officers at the Regional Fire Centre in Fort Smith. However training for seasonal suppression crews and casual firefighters has been delegated to the district level. In the Fort Smith District in 1979 there was an obvious lack of trained and certified personnel for fireline duty.

Recommendation 13:

An inventory is required of potential but untrained firefighters in the Fort Smith District in order to determine the scope of firefighter training programs possible for 1980 and 1981.

Recommendation 14:

It is essential that the firefighter training and certification program in the Fort Smith District be updated and expanded and that a high priority be placed on the training and development of native crew foremen.

Recommendation 15:

There must be a program for the encouragement, development and increased use of native people as firefighters, crew foremen, fire bosses, seasonal fire rangers, radio operators and lookout men. To coordinate this a full-time native northerner will have to be added to staff.

Recommendation 16:

The appointment in 1980 of one experienced fire specialist at the professional level, and one Assistant Resource Management Officer for many fire duties including dispatch of aircraft, is an urgent requirement of the Fort Smith District in order to plan and implement improved fire management practices.

Recommendation 17:

Because of the shortage of fire supervisory personnel in the Fort Smith District there needs to be recruitment and training of volunteers from other Divisions of the Department and from the Government of the Northwest Territories for supervisory assistance during fire emergencies.

8.8.3 Fire Prevention

Every fire that is prevented means one less to fight. In 1979, 20% of all forest fires were man-caused and 80% were caused by lightning. Ninety percent or 31 fires were started by campfires of trappers and recreationists. The fire prevention plan and implementation program is weak and requires improvement. The fire prevention program lost credibility in 1979 when large uncontrolled fires were seen to be burning without suppression action from the Forest Service.

Recommendation 18:

It is imperative that direct communication be made with trappers and recreationists in order to substantially reduce the number of campfires escaping into the forest.

Recommendation 19:

The fire prevention plan for the District requires a major revision including fire cause analysis, establishment of goals and a related action plan for implementation in 1980.

8.8.4 Administration

Many of the plans, records, maps, fire reports, statistics and history of past and current developments viewed by the Panel were lacking in continuity, clarity and accuracy. Accurate and up to date information on well organized records is necessary input into effective fire management planning and for uniform and accurate performance evaluation on each aspect of a fire control operation.

Recommendation 20:

All plans, forms, reports, and records relating to fire activities should be inventoried and critically reviewed in 1980 and proposals made for improved record keeping and an accurate data base.

8.8.5 Fire Weather Stations

Basic fire weather factors of rainfall, relative humidity, wind speed and temperature are needed from representative stations in order to compute the Canadian Fire Weather Index and prepare fire weather

forecasts. The Index is a numerical rating of potential fire intensity in standard fuels and it reflects the likelihood of a fire starting should there be a source of ignition. It is a valuable tool to the fire administrator because it provides short and long term guidelines for fire-fighting preparedness. There are gaps in the weather information because existing stations are too few to represent the large area of the district. The Pine Point weather station in 1979 provided incorrect data.

Recommendation 21:

Operational fire weather stations need to be located at all manned lookouts in the Fort Smith District in 1980.

Recommendation 22:

Fire weather equipment at all stations in the Fort Smith District should be checked for accuracy in May 1980 and all observers should receive refresher training in the care and reading of instruments.

Part III

Northwest Territories

Fire Management Policy Review

Chapter 9 The People and Values-at-Risk

9.1 Introduction

The present fire policy gives first-priority recognition to the preservation of human life and protection of communities and major works of high capital value. There was a strong feeling conveyed during our meetings and in submissions that this high priority of concern did not extend to many areas of resources also considered of high value by other people in the vicinity of their communities.

This section relates to the major concerns about fire expressed to the Panel and is provided for background to the sections which deal with development of policy and recommendations.

The concerns expressed stem from an alarm over the apparent amount and rate of burn in recent years, compounded by a perception of apparent unconcern among Forest Service staff for protection of the resources themselves. The two major demands were to apply a higher level of fire control to trapping areas which are important for cash-crop production, and maintenance of caribou winter range since that species is so important for production of meat and hides.

It is evident that people in every community had strong feelings for the land which they expressed with conviction. They also saw fire as a destructive force. There may be some recognition that fire does play a renewal role in many areas, but recovery is a long, slow process and when active trapping areas are burned over it does create an immediate hardship.

On the positive side, there was evidence of a strong proprietary interest in the land and concern about its management. With that level of interest it should be possible to mobilize substantial support for any positive management approach.

Representations made during the Berger Commission Inquiry and during meetings of the Dene Nation indicate that concern about fire has been long-standing since fire policy changes were effected in the early 1970's. The concerns expressed were not just a result of the 1979 season, although the large fires of that year certainly acted as a catalyst for the actions which led to this review.

Georges Erasmus, President of the Dene Nation, spoke to the Panel at the public meeting at Detah. He made the point that fires in earlier days were not fought, but at that time people lived a more nomadic life following the animals and did not stay in communities as at present. At that time if the animals shifted, so did the people, but there is not the same ability to do so now. In addition, the purely nomadic life was very hard resulting in a short life expectancy. Compounding the problem now is the fact that there are more people and more demands on the land so that there are not the same opportunities to move around. There is concern that if excessive fires unduly disrupt the opportunities to live on the land then people will lose the opportunities for independence and the way of life which has sustained them will be lost.

There is considerable question over the ability of the land to sustain a traditional lifestyle for all who may wish to avail themselves of it. With increasing pressures and a finite capacity to produce there must be limits. However, the strong interest expressed suggests that there is a need to apply higher level of management than is presently the case.

9.2 Wildlife

9.2.1 Introduction

For those living close to the land, availability of wildlife in its variety is a major concern. Wildlife, its harvest and use of the products represents food, clothing, cash income, way of life, and recreation. Since virtually all land provides wildlife habitat of some sort, fire on any land has an impact on wildlife. In addition to traditional values, food products take on a real value in light of food costs in northern communities.

9.2.2 Barren ground Caribou (*Rangifer tarandus greenlandicum*)

Strong concern over caribou was expressed in every community where caribou forms a part of the traditional diet. Great concern was expressed about maintaining both caribou numbers and their availability. Fire was seen as a force which contributed to a reduction in the winter range availability and which could deflect caribou herd migration away from traditional hunting areas. Kelsall *et al.* (1977) summarize the current state of the art as follows:

"The barren ground caribou of the western Canadian boreal forest and of adjacent tundra have been the subject of one of the most comprehensive and continuous research programs devoted to major mammals in North America. Studies have been continuous since 1947. However, the resulting reports and publications, and comparable studies in Alaska, present a picture that is not as clear as might be expected."

Although studied continuously since 1947, knowledge of fire-caribou relationships is still not clear. Early studies were launched in response to apparent serious declines in caribou numbers and focused in many instances on the serious effects of large-scale fires which many believed to have contributed to the decline through reduction of winter range. That question is still open. Scotter (1967) concluded that "there can be little doubt that forest fires have been the causes of (caribou) decline." He felt that the reduced carrying capacity of the forest did not appear at the time of his study to have been the factor limiting caribou, but it might well have been the factor responsible for "the reduction." At the same time, there is also evidence to suggest that fire does have a role to play in maintaining caribou winter range — but up to a point.

Lichens appear to form an important component of caribou winter diet in this region. Scotter (1980) stated that lichen forms 55% of the diet based on weight, and indicated that this could be underestimated in studies since lichens are easily fragmented. Miller (1979) found that caribou foraged primarily on lichens in February and April in both Manitoba and Saskatchewan. Lichens comprised 39 to 52% of the total rumen contents on an air-dry weight basis. Kelsall (1968) showed that the diet contains 40% lichen. DeLeonardis (1980 personal communication) commented that reindeer herded in winter on the Seward Peninsula in Alaska would disperse to other areas when lichens were not available.

Scotter (1967) shows that the high-value lichens reach a state of abundance about fifty years after fire. The peak abundance was reached in forest stands 120 years of age or greater. Miller (1979) states that in Saskatchewan the youngest stands supporting lichen forage supply utilized by caribou was 46 years and in Manitoba 54 years, substantiating Scotter's observations.

In a drumlin area 240 km (150 mi.) east of Fort Smith, Kershaw and Rouse (1976) found that caribou grazing is restricted to the *Stereocaulon* lichen phase, and pointed out that the 75 year old burns are dominated by *Stereocaulon paschale* which lasts up to age 150 years. The lichen cover is then replaced by a carpet of mosses and herbaceous plants, typical of the final recovery phase. The start of the major period of decline of this species is about 150 years after the burn. Scotter (1980) comments on the importance of *Cladonia mitis* and indicates that good caribou range is maintained for about 50 to 125 years.

Scotter (1972) reported "at the southern limits of the barren ground caribou's winter range, fire sometimes destroy thick carpets of bryophytes in upland forests thereby making them more productive for lichens and other forage plants. But this advantage is more important in the closed forest stands. Fires also improve certain muskeg areas by destroying *Sphagnum* spp. and other bryophytes which are replaced with forage preferred by caribou."

These comments and figures for winter caribou ranges suggests that the years between 50 and 150 post-fire are the most produc-

tive, at least for caribou winter range in the south. To optimize winter range production it would appear beneficial to subject ranges older than 150 years to fire, but to exclude fire from other areas. This approach is too simplistic for it disregards the difference in response of upland and lowland sites. However, it does apply to the upland sites which appear to be the most important for caribou. Based on these figures — an annual "acceptable" rate of burn would appear to be between 0.7-1.0% assuming that the area already has more or less evenly distributed age classes.

These suggested rates of burn compare favourably to the "normal" rates found by Scotter (1964) which were close to 1% per year, and to Miller's (1979) observed 0.7 percent in Saskatchewan. Miller also found 0.2 percent in Manitoba but for a ten-year period in contrast to the fifteen-year period for Saskatchewan.

Another concern about large fires mentioned by Scotter (1980) was the possibility of deflecting caribou movements, and possibly effectively blocking herds from reaching other portions of the range. He suggests that this effect may be even more critical than the forage loss. Scotter observes that while a few caribou might make it through a large burn, and a large herd might move through a small burn, a large herd meeting a large burn could well be deflected. He believes that there is evidence to show some effect, but not sufficient information is yet available on which to judge. Avoidance of recent burns may relate to a combination of factors including lack of lichen forage, hardness of snow in the open areas making forage effectively unavailable, blowdown obstructing travel, or simply random change in herd movement patterns.

These aspects suggest special factors which should be considered in deciding on the need for fire control action — the size, location and alignment of fires as they may affect caribou movement.

As reported in Kelsall *et al.* (1977), Bergerud (1974), who has reviewed the declines in North American caribou, has rejected the belief that winter food scarcity has limited this species. In his opinion, over-hunting and local increases in wolf predation have been responsible for the decrease in caribou. Scotter (1980), Miller (1980) and others also expressed concern over harvest levels, particularly now that aircraft are frequently used to find herd locations. On the other hand, many of the hunters at local meetings disagreed with this point.

Until it is known the degree to which availability of winter range is a limiting factor to caribou population levels, and until those responsible for managing caribou determine desirable population levels, we believe that a level of fire control should be applied to maintain the range within the limits suggested above — an average annual rate of burn of about 0.7% to 1.0% in the south, to possibly 0.5% in the north.

9.2.3 Woodland Caribou (*Rangifer tarandus caribou*)

The importance of woodland caribou was mentioned at the communities of Wrigley, Fort Simpson and Fort Providence for the area around the Horn Plateau and north. Not a great deal of information is available about this species and they are apparently relatively few in number.

Woodland caribou appear to require lichens for winter food, and are believed to decrease in numbers with burning of forests and destruction of food source (Peterson 1975, Crangan 1958). In this respect woodland caribou appear to be affected by factors similar to those of the barren ground caribou on forested winter range.

9.2.4 Moose (*Alces alces*)

Moose was mentioned in virtually every community as another big

game meat-producing animal of importance. Except in a few southern areas where caribou are not present, moose was seen as second in importance to caribou. Reported harvests in 1975-76 show 12 times as many caribou harvested as moose (Manecon 1980).

Moose range from the south all the way north to treeline, and into the barrens in places where willows are available (Monaghan, 1980). The northern population densities are relatively low except in isolated pockets. Because of their size they are important meat producers, and their hides are valued also.

As reported in Kelsall *et al.* (1977) "mature coniferous forest supports few moose. Successional growth that is rich in aspen, birch and willow supports many moose, particularly in early and middle stages of growth." The general view is that fire is one of the most important factors in creating suitable habitat for moose and that their abundance varies considerably with successional stages. The optimum successional stages for moose will occur between 11 and 30 years after burning, but Kelsall adds that the exact stage of optimum habitat would depend on the characteristics of the individual site. The optimum stages in northern areas are not documented.

It is interesting that during our public meetings no one in the northern communities saw fire as beneficial to moose. It was not until we visited in the south-western part of the Northwest Territories that there was some allowance that in some areas resprouting of succulent willow and aspen might be favourable for them. The responses raised the question again of diversity within the region and the apparently longer response times in the more northern areas for vegetative recovery. There are many questions yet to be answered in that part of the country.

Kelsall *et al.* (1977) state that pertinent information allowed the conclusion that in Alaska, at least, increases in moose numbers will not occur in mature coniferous forests, but will not invariably occur following extensive burning. He comments that it is probable that fires of different intensities cause varying response by browse-yielding plants, and browse availability is affected, too, by snow cover.

The view was expressed by some non-hunters during individual interviews that if caribou range suffered as a result of fire, that moose would form a replacement species on the burns. At first glance, Scotter's (1964) work appears to substantiate this. He observes that while fire appears to reduce the quantity of range for barren ground caribou, fire improves it for moose on upland forests. However, the number of moose and caribou pellet groups were actually the same in one to ten year-old stands, almost 3:1 in favour of caribou in the 11 to 30 year age class, and moose decline sharply in both absolute and proportional numbers from that point. There is a weight difference between the species, but Scotter concludes by stating that the biomass of caribou per acre of mature forest appears higher than that of moose on early sub-climax forests on upland sites. Thus in terms of meat production, the upland forests may well be best suited to barren ground caribou use.

The studies by Lewis (1977) suggest that prescribed spring fire was once used to improve moose habitat by the Slavey Indians in northwestern Alberta. Prescribed burning techniques along these lines may well have application in the south-western part of the region. The feasibility of applying it in northern areas requires some further study. It is significant to note that these fires were virtually all spring burns, as distinguished from high intensity summer fires.

9.2.5 Bison (*Bison bison*)

Concern was expressed about bison by speakers at Fort Providence who were familiar with the Mackenzie Bison Sanctuary. Starting with 16 in 1962 there are now an estimated 700 animals, and the local people have developed a strong protective interest in them.

Allison (1979) reports that bison feed from open slough sedge and reedgrass, and tend not to browse. Wet meadows are primarily

favoured (Reynolds *et al.* 1978). She further reports that open grass/sedgelands used by bison were probably developed and maintained by a combination of fire and flooding or by fire alone. In the absence of those disturbances willow and other woody species invade the open areas. Although estimates of carrying capacity of the bison prairies far exceed the numbers of animals present (Reynolds 1976), winter and summer habitats will decline in area and quality if fire is excluded on their ranges (Jalkotzy and Van Camp, 1978).

The fear expressed at Fort Providence was that late season fires could destroy winter food reserves, and a large intense fire could drive the animals themselves into Great Slave Lake. These conditions suggest the possibility of using prescribed burns in the spring for range improvement. They also suggest that in this area the Forest Service be encouraged to apply selected attack strategy on fires to meet range management objectives established beforehand, considering the time of year and location of the bison. Development of the range management plan would assume a cooperative effort with the NWT Wildlife Service, and consultation with hunters and trappers.

9.2.6 Furbearers — Introduction

This group of animals along with barren ground caribou were most frequently mentioned as a serious concern in connection with forest fire. Trapping represents a cash income enabling many to make at least a partial living from the land, or to provide income supplements to enable financing of hunting of caribou. The trapping activity was commonly related to hunting and together represented a major component of the traditional lifestyle. Fire, again, was seen as a destructive phenomenon.

The immediate impact of fire is to depress populations of all species. The ability of the furbearing species to recover after a fire is dependent on habitat requirements for food and cover, potential population growth rates, and rates of dispersal which affect the rate of recolonization of burned areas. Unfortunately, very little work has been directed specifically to fire's impact on furbearers (Bunnell, 1980).

Table 9.1 lists fur production in the Northwest Territories for the year 1978-1979. Species are listed in order of importance according to pelt value. The number of pelts is probably more pertinent in assessing importance from the standpoint of trapping activity, since fur prices fluctuate so violently from year to year.

Considering the importance of these animals as brought out in virtually every public meeting and a number of submissions to the Panel, background comments on nine of the most significant species is provided. These are all drawn from a sub-contracted study by Bunnell (1980).

9.2.7 Marten (*Martes americana*)

Marten was mentioned by every group of trappers as one of the major species sought. Bunnell found that during the past ten years when pelts have been worth less, pelt value has had no influence on the harvest, substantiating our impression that marten is a major fine-fur species taken regardless of revenue obtained.

Although marten are commonly assumed to be residents of mature coniferous forest, and that they prey to a great extent on red squirrels with their populations fluctuating according to squirrel numbers, both assumptions are only partially true (Bunnell).

Early workers reported that the type of cover best suited to a marten was mature or decadent forest communities. It is thus not surprising that fire was frequently cited as one of the major factors causing disappearance of marten from its range. Marten avoid areas without cover overhead such as unrestocked burns, logged areas and open creek bottoms.

Marten use a wide variety of food, but squirrels rank second; frequently a distant second to smaller rodents. Microtine rodents (meadow and red-backed voles) were the major food items found in studies in Alaska, British Columbia, Alberta and other northern areas including parts of Russia. Berries and other vegetation comprise a significant component of the diet in late summer and early fall.

**Table 9.1: Fur production
of Northwest Territories, 1978-79¹**

Species	Value of Pelts		Number of Pelts		Discussion
	Total Value	Rank	Total	Rank	
Lynx	\$1 388 416.00	1	4 539	8	yes
Marten	856 498.00	2	23 309	3	yes
Arctic fox (blue and white phases)	789 610.75	3	20 094	4	yes
Polar bear	508 397.00	4	466	14	no
Red fox (cross, red, and silver phases)	504 378.00	5	4 433	9	yes
Muskrat	476 651.00	6	104 036	1	yes
Ring seal	345 772.00	7	25 935	2	no
Mink	310 622.00	8	8 610	6	yes
Wolf	282 629.50	9	1 326	12	no
Beaver	150 476.00	10	6 278	7	yes
Harp seal	51 161.00	11	2 100	10	no
Seals (other)	18 852.45	12	1 317	13	no
Wolverine	17 213.00	13	78	16	no
Squirrel	14 535.85	14	9 677	5	yes
Fisher	9 641.00	15	78	16	no
Otter	6 191.00	16	86	15	no
Bears (other)	6 041.00	17	64	18	no
Weasel (ermine)	2 020.90	18	1 632	11	yes
Coyote	675.00	19	12	19	no
	\$ 5 745 452.15				

¹ Summarize from statistics provided by the Wildlife Service of the Northwest Territories.

The food habits reflect a more diverse habitat than continuous conifer forest, indicating that marten also use open areas. It has been noted that fire had been an important agent in establishing and maintaining a diversity of cover and food types favourable to them. Home ranges often coincide with large meadows and burns.

Marten do survive best in closed canopy, coniferous forest in the winter, but they can and do exploit open areas in the summer. The most common prey item, mice, live in young as well as older forest stages. Snow conditions under closed-forest canopy permits effective predation by marten that is not possible in the harder snow of open areas. It is likely that the marten require a diversity of habitats, but must have coniferous forest with closed canopy to survive

well in extreme winters. Closed canopy conifer habitat appears essential, and forest edges desirable.

Large fires likely would eliminate use by marten although adjacent individuals would use the edge of the burn and benefit from it in the summer and fall. Observations in Alaska by Lensink (1953) indicated that treeless areas and areas on which aspen and birch dominated following fire were abandoned by marten. He concluded that effective management of marten requires control of forest fires.

Koehler and Hornocker (1977) noted that dry sites were not suitable for voles. Extensive burns over the Canadian Shield region would almost certainly increase dry habitat to the disadvantage of marten, an effect which might also develop downwind.

In summary, it seems that small burns would benefit marten, but large burns would reduce numbers, possibly for decades. Adding to the difficulties in managing marten, in the face of widespread habitat alteration, is the fact that reproductive potential is not great. Marten are also easily over-harvested, a point substantiated by comments among trappers that they frequently rotate traplines to leave areas lie "fallow" to allow a period of recovery.

9.2.8 Lynx (*Lynx lynx*)

For harvest of lynx is influenced strongly by snowshoe hare (*Lepus americanus*) population cycles. Lynx depend almost exclusively on the hare for sustenance. The response of hare to fire is thus critical in assessing the impact of fire on lynx. In a study of hares in north-central Alberta, Keith and Surrendi (1971) found that hares abandoned severely burned sites, but complete reoccupation of the area occurred in the second summer following fire when brush cover had developed. This point we believe to be critical in northern ranges where vegetative response may be much slower, particularly on severely burned sites. A number of trappers pointed out that brush and trees had to be present not only for food, but high enough to provide cover when winter snow accumulated. Recovery times of up to twenty years were commonly mentioned.

Lynx are considered to be largely restricted to mature boreal forest. Although many of the prey items are not restricted to the forest, it is likely that with lynx, as for marten, the major value of forest cover is its modification of snow characteristics and influences on prey availability rather than on prey numbers. The influences of fire upon prey availability are unlikely to be seriously detrimental to lynx unless burned areas are greater than about 10 km (6 mi.) in any dimension. This aspect of fire size recurs frequently and will be addressed later.

9.2.9 Red Fox (*Vulpes vulpes*)

The red fox is wide-ranging, occurring in arctic and alpine tundra, along swamp and marsh edges, along river valleys, in dry uplands with open areas and woody patches of cover. Although they may occur at low densities in dense forests, they prefer semi-open areas and natural clearings within forest cover. That preference likely results from their food preferences and denning requirements.

Small mammals form the principal prey which, in the North, are likely to be voles, mice, muskrats, snowshoe hare and squirrels. With the exception of the squirrel, these are species of the early, more open stages of plant succession. To the extent that fire encourages more open landscapes and early forest growth, it should be beneficial to foxes.

As with all other species discussed, the immediate impact of fire would be to depress populations. It is likely that areas in which fox populations were depressed by fire would be recolonized rapidly, depending on availability of voles and mice to provide ample food supplies.

9.2.10 Muskrat (*Ondatra zibethicus*)

Muskrat seem capable of inhabiting any water body that does not flow rapidly and is not subject to rapid fluctuations in water level. Ideally, the water should be deep enough that it does not freeze to the bottom and not so deep that submergent vegetation is eliminated. In northern ranges muskrat forage mainly on vegetation.

Most authors consider wildfire to be beneficial to muskrat. In the south, prescribed burning has been a major muskrat management tool for decades, the rationale being that fire keeps marshes at a stage most productive of key forage species. Large burns that grossly modify the flow rates of water courses could prove detrimental.

The trappers at Fort McPherson told of the Mackenzie Delta as an example of an area which had maintained a high degree of productivity for muskrats without fire. In slow-growth northern areas fire may be less important. Periodic flooding in the Delta also has a bearing on maintaining habitat productivity.

9.2.11 Mink (*Mustela vison*)

Mink inhabit a range of habitats but are generally near stream banks, lakeshores or large marshes. Small rodents and fish make up the bulk of the diet. In the North it is likely that muskrat is the major rodent preyed upon. Mink have no specific cover requirements.

Fire is unlikely to affect mink adversely. In the same manner that fire maintains muskrat habitat, it could be beneficial to mink. To the extent that streamsides enjoy some immunity from smaller fires, so would the mink. As with the beaver or muskrat, extensive burns that encouraged flash floods or erosion would be detrimental.

Trappers in the Fort Smith area have pointed out that although mink may not be seriously affected along water courses, their availability alone cannot maintain the viability of a trapping area that has burned over.

9.2.12 Beaver (*Castor canadensis*)

As beaver are almost entirely absent from conifer-dominated, late successional stages, fire could be viewed as important in maintaining beaver habitat. Beaver can survive only where species of poplar (particularly aspen), willows, alder, birch, or water plants are available as forage. They live in streams, in muskegs, or in tundra and alpine meadows. The absence of trees as construction material for lodges is not necessarily detrimental as many populations live entirely in bank burrows.

For cover and food, the most direct impact of fire is the maintenance and creation of the more valuable, early successional vegetation stages. Indirect influences would be evident through potential effects of fire on the drainage basin. Although occasional small, localized burns likely would be beneficial and would enhance beaver habitat, larger burns encompassing entire watersheds could leave streams clogged with debris and subject to both flash flooding and extensive erosion. Both flash floods and erosion would work to the detriment of beaver populations and inhibit recolonization. Rates of recolonization of smaller burns are unclear as the beaver possesses a moderate reproductive capacity although it disperses widely.

Bunnell summarizes by stating that provided burns are not extensive (covering an entire watershed) nor intense, it seems likely that beaver populations will be suppressed only slightly and for a short duration, if at all. Complete elimination of fire in Canada's boreal forest would result in a decline in beaver populations.

A concern expressed frequently by trappers at our public meetings was that when beaver feeding areas were burned out the resident population of beaver would starve. Periods of up to twenty years were commonly given as the intervals before which beaver

populations would again establish after burns. This may well be a reflection of both the slower rates of vegetative recovery in the North and the size of some of the northern fires which result in long recolonization periods.

9.2.13 Red Squirrel (*Tamiasciurus hudsonicus*)

Although the red squirrel is of relatively minor economic importance as a furbearer, it ranks third in total pelts harvested. It is therefore of importance in terms of trapping activity.

The red squirrel is one of the few mammals that prefer mature coniferous forest habitats. Its dependence upon cones for successful over-wintering dictates the squirrel's requirements for coniferous forest that is old enough to produce fertile cones. In the northern portions of their range the female cones of black and white spruce are most important.

Recovery periods following fires have not been documented in the North. Ahlgren and Ahlgren (1960) reported that squirrels were eliminated for 10-25 years following burning even in the south eastern U.S. forests. It is likely that squirrels would be absent for at least 25 years following fire in the north. A study in the Yukon indicated that the harvest of squirrels had not recovered twenty years after burning (Bunnell). Of the species considered here, the red squirrel is the most likely to be seriously reduced by fire and the least likely to recover within twenty years of burning. And, of course, this is significant for marten as well.

9.2.14 Weasel/Ermione (*Mustela ermineae*)

Ermione inhabit a wide range of conditons but are generally more abundant in boreal coniferous and mixed forest. Their preferred habitat is susceptible to fire.

Although not restricted in food habits they forage mainly on small rodents, voles and deer mice. Given their apparent flexibility in habitat utilization and denning sites, the major effects of fire are likely to be through the impact on prey species. The recovery of their major prey is likely to be slower in the North in line with rates of plant succession, but is unlikely to exceed ten years. The species has the potential for rapid population growth.

If temperate experience is transferable to the boreal region, one might expect an increase in ermine numbers in the following first decade after fire. This would be in response to increased availability of prey species.

9.2.15 Furbearer Summary

A summary of the major implications of fire to these selected furbearers is shown in Table 9.2 prepared by Bunnell (1980). The summary is based on a review of literature relating to the biology of the species that are relevant to potential impacts of fire, and includes evidence based on observations in the Yukon. As Bunnell pointed out, very little work has been directed specifically to fire's potential impact on furbearers, and even less has been done within the Northwest Territories. The relationships described here are probably strongly indicative of fire effects, but are subject to adjustment in light of further studies.

Many trappers commented on the effect of smoke on furbearers. In this observation heavy smoke causes animals to "move out". Some trappers in the Fort Smith area report generally poor catches during the winter of 1979-80 even on areas which were not burned.

This poses an intriguing question which is apparently not mentioned in literature.

9.2.16 Other Species

There are many other species native to the Northwest Territories which may also be affected by fire. None of these was mentioned as a point of concern during the meetings so brief reference to them should suffice.

Dall sheep (*Ovis dalli*) and mountain goat (*Oreamnos americanus*) range along the western portion of the region in the northern extension of the Rocky Mountain chain. It is likely that fire plays a role in maintaining some of the alpine ranges on which they depend.

Fires are generally believed to benefit black bears (*Ursus americanus*) as reviewed by Kelsall *et al.* (1977). Burns provide crops of berries which make up a substantial proportion of fall food. In view of their omnivorous eating habits they are believed to be fairly adaptable.

Grizzly bears (*Ursus horribilis*) occur along the forest-tundra edge from Great Slave Lake to the north and west, and west of the Mackenzie River and throughout the mountainous areas. Very little literature is available on fire effects on grizzly bears. Since they are also omnivorous it is likely that they, too, would benefit from rich, young and medium-aged succession (Kelsall *et al.* 1977).

Wolves (*Canis lupus*) are found everywhere in the North. When caribou are present, wolves depend on them absolutely, and would therefore be affected by fire as were caribou. Wolves feeding on other species such as moose and small game would also be affected to the extent that the prey species were.

Musk-ox (*Ovibos moschatus*) are primarily tundra animals. Allison (1979) comments that there is no reason to assume their

habitat to be threatened by fires. This may well be the case, but since tundra fires have been known to occur, and since they could affect immediate availability of forage on critical winter ranges, some further study and observation may well be in order.

The effects of fire on birds is reviewed by Kelsall *et al.* (1977). He states in summary that the available evidence suggests that fire provides a diversity of habitat which, in turn, provides for a diversity of birds. When fire burns a mature coniferous forest, the numbers of spruce grouse (*Canachites canadensis*) diminish because their optimum habitat is destroyed. At the same time, however, new habitat is created eventually for ruffed grouse (*Bonasa umbellus*). The succession of trees in a forest is followed at each stage by a succession of bird species particularly adapted to the conditions of the moment. The evidence also suggests that although nests and young birds in forests and marshes may be lost to fire during the nesting season, the longer term effect is generally beneficial.

Particular reference to a number of prey species of birds, some of which are rare or endangered, is made by Allison (1979). Falcons, gyrfalcons, bald eagles, osprey and other raptors return year after year to a traditional nesting site. Fires may change surrounding habitat or even burn a nest and nest site. However, she states that fires in the vicinity of nest sites probably have largely beneficial side effects by allowing increases in prey populations. Many birds which nest in dead trees may take advantage of snags remaining after a fire has passed through an area.

The caution here, again, in our view is that fires of high intensity and large size could lower recovery rates and availability of prey. On the other hand, activities associated with firefighting, particularly aircraft use, could be disturbing at nesting times. We note that the Land Use Information series of maps prepared for Indian and Northern Affairs do make note of known critical habitats. This suggests that it would be appropriate to identify these in a way easily referenced for guidance during fire action.

Table 9.2: Summary of major implications of fire to selected furbearers

Species	Implications From Species Biology	Empirical Evidence
Beaver	— most smaller fires (<5 km ²) beneficial at frequency of 30 to 60 yrs — extensive fires altering hydrology detrimental	— increases 5 to 8 yrs post-burn — decrease 12 to 18 yrs post-burn
Muskrat	— smaller fires beneficial at frequency of 10 to 25 yrs — extensive fires potentially detrimental	— little effect 5 to 6 yrs post-burn — decrease 14 to 18 yrs post-burn
Mink	— as for beaver	— decrease 5 to 6 yrs post-burn — decrease 14 to 18 yrs post-burn
Arctic fox	— no effect	— no evidence
Red fox	— short-lived effect; recovery within 5 to 10 yrs post-burning	— no evidence
Lynx	— mature forest necessary as winter cover	— no evidence
Weasel (ermine)	— area extent unimportant; recovery within 5 to 10 yrs	— recovery over period 5 to 8 yrs post-burn — decrease 16 to 18 yrs post-burn
Squirrel	— mature forest necessary; little recovery before 25 yrs	— recovery begins 17 yrs post-burn
Marten	— mature forest necessary as winter cover; burns benefit summer forage	— 8 marten taken 17 yrs post-burn

9.2.17 Waterfowl

Particular references were made to waterfowl at public meetings, along with other wildlife species, but there were no major concerns expressed. The summary by Kelsall *et al.* (1977) is generally positive in its view of fire effects.

"Although fires raging through a marsh in spring will destroy nests and young waterfowl and other birds, general opinion seems to be that the burning of marshes is beneficial in the long run. Fires rid marshes of dead grass, sedges, and shrubs, and makes new shoots available to furbearers, and waterfowl."

"Fire also opens up dense marsh growth to a degree that suits feeding waterfowl. According to Ward (1980), in fact, 'unless the large marshes of Manitoba are managed for waterfowl with fire as the major tool they will cease to exist as marshes'. This situation would result because the heavy growth of marsh vegetation would produce a litter of organic material that would completely block and fill in shallow waters within a few years. Summer fire would probably damage plant roots, and its possible long-term benefits would be greater because it would create more open areas and edges. Klein (1971) states that the productivity of several major waterfowl areas in interior Alaska seems to be maintained by two natural factors, periodic flooding and periodic fires".

Few, if any studies seem to have been conducted with respect to waterfowl and fire within the forested area of the Northwest Territories. Because of the longer vegetative response time characteristic of that country, additional studies concerning the effect of fire and repeated burning would appear appropriate.

9.2.18 Fish

Fish is an important component of "country food" utilized by northerners for themselves and their dogs. During the public meetings there were various references to dead fish observed after fires had passed through, reflecting concern over the maintenance of fish populations.

In a number of other instances, observations were made that although many of the larger lakes were still good for fishing after large fires had occurred, the value of them was much reduced since there was no hunting or trapping in the vicinity, nor good camping areas remaining.

Fire effects on fish were reviewed by Northcote (1980) in a sub-contracted study and are reviewed also by Kelsall *et al.* (1977). Both authors point out that impacts on aquatic ecosystems and particularly on fish have not been well covered. Very little information is available for the Northwest Territories. Kelsall comments that most recent literature provides little cause for alarm concerning the possible effects of fire on fish in the boreal forest. The few direct references to the effects of fire on fish are typically more provocative than informative. He cites Ahlgren and Ahlgren (1960) who state that fish are frequently killed because of the wash of ash into lakes and streams after fires. Another account by Hakala *et al.* (1971) recorded that salmon mortality was extensive immediately following a 34 400 ha fire on the Kenai Peninsula in Alaska in 1969. The causes of this mortality were unknown, and there were no long-term effects.

Impacts of forest fire on fish must depend to a large extent on the kind of habitat being utilized. Most severely affected, at least in the short-term, would be small streams and tributaries where a major fire could effect drastic changes in water quality. Least affected would be large lakes, such as Great Slave and Great Bear, except where their fish populations might be dependent at some stage on tributary conditions. Small lakes, especially those served by large watersheds, might collect significant impacts and be affected for a long time after a major fire.

There are 34 species of fish in the Northwest Territories repre-

senting fourteen different families. Many of the species may spawn and rear in streams and rivers where they may be more vulnerable to effects of forest fires. In this group are many species of importance to man for food, recreation, or commercial purposes, including the goldeye, several of the whitefish, arctic grayling, salmonids and smelt, suckers and yellow walleye.

Effects on streams reviewed by Northcote are discussed under six headings. In brief review high peak flows as a result of fire-induced flooding can have a detrimental scouring effect. Fish have narrow tolerance limits to temperature, and where small streams in forested watersheds are exposed to severe burns water temperatures may be quickly raised to levels well beyond the upper lethal limit for most species of fish. This would particularly be the case where heavy fuel accumulations were present along the stream, and when fire occurred at times of fish concentration for spawning. General increases in stream temperature have been noted as a result of removal of shading along stream banks, but have not shown to be detrimental. Increase in sediment and turbidity have been documented in streams as a consequence of fire. This could have undesirable effects through siltation of spawning beds. Chemical concentrations may increase as a result of run-off from burns. In nutrient-poor conditions this may prove advantageous.

Fire retardants may cause direct mortality of fish in watersheds if concentrations reach lethal limits. DAP-based retardants are lethal at rather low concentrations. It would appear prudent to avoid retardant drops in or along watercourses.

In summary, no sweeping generalization are justified. According to Northcote there seems little doubt that locally severe direct mortalities to fish may occur as a result of forest fire within the treeline of the Northwest Territories, and that in some cases severe indirect mortalities or reduced fish populations may result for several years after such a fire. On the other hand, not all fires in these regions can be expected to produce such effects, and indeed some may even result in long-term benefits even though initial impacts may be detrimental.

With the exception of fish concentrations in critical spawning times and in areas of particular erosion susceptibility there does not appear to be a need to apply intensified levels of fire control for the needs of fish alone. However, the effects of large fires which can result in compounded effects in water courses bear further consideration.

9.2.19 Summary — Role of Fire in the Forest

Many studies have demonstrated that fire has affected the structure and composition of the boreal forest (Rowe *et al.* 1974 and 1975, Johnson and Rowe 1977, Tande 1977, Hawkes 1979, Heinselman 1978, and others). Fire is the major agent which destroyed forest communities and thereby initiated growth of new ones. In the process a mosaic of forest communities was created composed of areas of different age classes and often different species, forming patterns of different sizes and shapes. The "edge" and diversity thus created provide varied habitats for various wildlife species.

In their study of fires in the Northwest Territories Rowe *et al.* (1975), for example, conclude that

"Fire is a natural phenomenon in the forested parts of the Northwest Territories and possibly also along the forest-tundra boundary. Evidence indicates that fires have always been present and will continue to occur given the normal accumulation of organic fuels with time. The usual agent of ignition is lightning."

If this is the case, it follows that forest communities have adapted to fire in some way, re-establishing themselves after fire through successional phases. Animals, too, respond to the re-establishment of plants, the various phases favouring different animal species. Even winter range for caribou needs fire to reduce competition to lichen from mosses. Fire in this sense does play a renewal role, maintaining a diversity, and in the long run can be seen as beneficial. But fire is a destructive agent, and when it destroys resources of value to man it is seen as undesirable, especially in the short run.

If from an ecological standpoint some fire is desirable and from a human standpoint too much fire is undesirable, where does the acceptable balance lie? It appears to the Panel that the most important aspects which bear on both the ecological and human need are those of frequency and size of burn.

Rowe *et al.* (1975) addressed this point from an ecological standpoint in their list of concluding points. They put it this way.

"Probably the most important unknown aspect of fire is the effect of recurrences at various intervals. Assuming that northern ecosystems owe their present compositions and structures to particular regimes of past fires, the key problem becomes one of determining those regimes. Frequent fires at regular or irregular intervals will 'produce' certain patterns of vegetation and animal habitat, infrequent fires will 'produce' something else. But what statistical distribution of recurrence intervals obtained in the past? If this were known for particular geographic areas and types of terrain, then management procedures in the future could be given guidance."

They suggest a top priority study in fire history to try to determine what nature's way had been.

Most studies are concerned with determining the "natural" role of fire. However, it is fair to ask whether or not "natures" way is always best to meet human needs. For example, man is unwilling to accept the consequences of natural catastrophe such as drought or floods. In management of agricultural lands, food production has been greatly enhanced through improving on "nature" in a variety of ways. Is it not possible to anticipate a more optimum approach to fire management, too, to meet defined needs?

The question of fire frequency can be looked at in two ways — one as deduced from the history of natural fires in the past, the other reasoned to best meet the objectives for production from the land.

The historical or "normal" rate near latitude 60 degrees appears to be about 1% per year. Johnson and Rowe (1977), in their study of the caribou range, showed that approximately 0.9 of the total area burned annually from 1966 to 1972. A study of satellite imagery north of Yellowknife (Rowe *et al.* 1975) also showed an annual rate of 0.9%. Scotter (1967) found an annual burn rate of about 0.7% in his study in the Northwest Territories in the caribou range area east of Fort Smith, based on a four-year period 1961-64. Dube (1979) analyzing records for Wood Buffalo National Park for the last eleven years found an annual rate of burn of 0.85%, even with fire protection extended to the area. In northern areas the rate appears to be less.

Rowe *et al.* (1975) state that their data indicate a decreasing annual percentage of burn from south to north in the region. Bradley *et al.* (1978) found an average annual burn rate of 1% about normal for the Precambrian Uplands. Low sub-arctic terrain they believed, would experience a lower burning rate, and a probable fire rotation of 150-200 years was suggested. The aging of trees in the low sub-arctic has shown that stands older than 200 years are very common. This indicates a possible annual rate of 0.5%. Rowe (1979) cites rates of 0.51% for southern Mackenzie districts and 0.18% for

the northern Mackenzie.

It might be postulated that the "normal" rate of burn in southern areas approximates 1% per year while in northern areas and in areas of higher elevation the rate of burn may be 0.5 per cent or even less.

The alternative approach is to try to postulate "desirable" rates of burn based on recovery times of vegetation and wildlife, and in light of human needs as reflected in management objectives. For example, Scotter (1980) advised that the most important lichen species in the caribou range area in the south regain abundance about fifty years after fire. They maintain a high rate of availability until about 150 years after fire at which time they begin to be replaced by mosses. If the management objective was to manage for caribou winter range only we could postulate a fire rotation of about 150 years, or an average annual rate of 0.67 per cent. This is a little less than the "historic" rate of 1%, but suggests a range of values within which to work. Of course, this example is too simplistic, ignoring the diversities in sites and growing potentials, and disregarding the effect on other species and products from the land. However, it does suggest an approach for developing a rational basis for making fire management decisions. Unfortunately, data is lacking for most of the Northwest Territories descriptive of the rates of recovery of plants and animals in the various regions. Best estimates will have to be used as a starting point.

The other aspect is fire size. Large burns can contain less "edge," may cause deflection of caribou migrations, and will take longer to repopulate with furbearers. They may have a drying effect which would result in longer vegetation recovery times and which could adversely affect surrounding areas. On the other hand, some large burns may have very irregular perimeters and may contain many unburned residuals. As a result the impact would not be as great. There are no references to optimum burn size. We suggest that the concept of maximum acceptable size is worth discussing.

9.3 Timber

Timber is a resource traditionally associated with forest management. It is interesting in this region that timber ranks lower in importance than such other forest-land products as meat and fur. However, timber does have value in some localities, and certainly has longer-term potential within the region as a whole. This section describes the timber resource at risk from fire. The economic importance of the resource is described in a following section.

The communities concerned with timber values were Fort Resolution and Fort Smith about the Slave River Valley timber, Fort Liard and Fort Simpson about the Liard River valley timber, and Fort McPherson about timber along the Peel River. These communities are either realizing economic gain from timber utilization, or see potential. Fire is seen as a major threat. During the summer of 1979, 31% of the saw timber in the Slave River Forest Management Unit was lost through fire (Gilmour, 1979). An additional 6.25 million board feet of timber were also lost in a 1971 fire. The Fort Liard community (1980) reports that extensive fires in 1942 burned much of the merchantable timber in the Liard River area.

Most of the timber-producing areas lie along the major watercourses described earlier. The best sites are on alluvial soil associated with the major rivers. Because of their proximity to the rivers these sites are generally not as ignitable as upland sites. However, the major danger to these in the past has come from larger fires burning into them from upland regions. This suggests that where these are to be protected, initial attack will be necessary in buffering zones.

There are also upland sites capable of growing timber, but they are often so scattered that they are not likely to become commer-

cially important. It is not necessary, therefore, to protect the entire treed area to sustain timber production.

Precise projection of forest productivity in the region is not possible since there is not as yet a comprehensive forest inventory. The major areas of standing timber have been identified through a number of special studies described by Gilmour (1969). An inventory of the Slave River Forest Management Unit has been completed, and one on the Liard is in process. Butters (in NWT Grade Stamping Agency 1979) cites an estimate that there is approximately 1.5 billion board feet presently along the Mackenzie River system from Fort Smith to the Mackenzie Delta, plus an additional 0.6 billion board feet along the Liard River from the 60th parallel, for a total of 2.1 billion board feet of potentially merchantable timber. These are estimates only, subject to confirmation through more intensive inventories. However, they do indicate a resource of some potential value. The estimates are based on trees of sawtimber size, and do not include volumes potentially usable for other fibre manufacture or energy biomass production. Projections by Reed (1978) and others indicate increasing world demands for forest products and restricted timber supplies. This situation will make utilization of timber in this region more attractive sooner than anticipated, particularly to meet regional needs.

More important than actual timber volumes in the long run are projections of allowable annual cuts which indicate the levels at which timber may be harvested on a sustained basis. Unfortunately, the operations at Fort Resolution and Hay River are based on a harvest level greater than can be sustained.

Reliable estimates of allowable annual cut (AAC) need to be based on adequate forest inventories which do not yet exist. Gilmour cites a 1972 Reid-Collins report in which the AAC for the entire Northwest Territories is estimated at 27 million board feet for sawtimber. This consists of approximately 20 million board feet from the Liard River Valley and the remainder from the Slave and Mackenzie Valleys. The figure seems to be based primarily on standing timber rather than on the growth potential within the region as a whole. The AAC suggests a four-fold increase possible over present production. On the other hand, Butters estimates an AAC of about 90 million board feet, of which 30 million would come from between Fort Smith and the Delta, and 60 million along the Upper Mackenzie watershed. Figures of rates of growth are also sketchy. Citing from a number of studies, Gilmour reports spruce sawlog rotation ages in the Liard Valley, for example ranging from 106 to 140 years, and estimates of mean annual increment for sawlogs of 1.3-2.1 m³/ha/yr (19 to 30 cu.ft./ac./yr. Growth in the pulpwoodsize material ranges up to 4.1 m³/ha/yr (59 cu.ft.).

Imprecision of estimates aside, there is a resource of value in place, and additional growth potential which offers promise for significant sustained economic contribution to the region. It appears worthy of a higher level of protection than is apparently the case at present. A more comprehensive inventory of forest productivity is also in order. Availability of satellite imagery and more sophisticated techniques of data analysis suggest that this may now be done at a relatively lower cost than previously.

Previous inventories have put emphasis on areas where standing timber of merchantable size is already present. Of equal importance in the long run is to identify sites with commercial forest growth potential on which there are not now trees of merchantable size, but which may be supporting young growth or are amenable to regeneration. It is important to identify these and to protect those with reasonable chance of accessibility to grow the crop of wood products which will be needed in future.

Growing timber on the riverine sites appears to be highly compatible with fur and meat production according to comments from hunters and trappers. These sites are sufficiently varied that there is a great deal of "edge" which is conducive to production of both moose and fur.

A program of reforestation was frequently recommended as a post-fire treatment, especially in timber-producing areas. This suggestion has merit, for although forests are renewable, it often takes positive action to effect the renewal process. Of some concern also is the lack of attention to forest regeneration after logging. It is important to give greater stress to this aspect through active post-logging treatments to ensure re-establishment of a new crop. Reforestation could be done with government funds directly or through a contract, or could be attempted through the operators on a negotiated incentive system.

A concept of seasonally adjusted fire protection zones is put forward by Reid-Collins in the Gilmour (1979) report. Since the major danger to the timber-growing areas is from large fires moving into the area, they suggest extended attack zones providing buffers at varying distances from prime sites. The largest buffer exists in June, the smallest in September, reflecting the seasonal growth potential of fires within those areas. That concept might also be adapted to projections of fire danger based on the Fire Weather Index, also reflecting fire growth potential. A similar result could be achieved through rapid initial attack within a larger "buffer" area followed by a decision on further action should the fire get away, the decision weighted by probabilities of fire spreading into critical areas. This is elaborated on in the Recommendations section.

9.4 Physical Resources

9.4.1 Communities

The town of Pine Point in its brief focussed on the 1979 fire threat to that community — the threat of total evacuation and possible destruction. This threat was the second in an eight-year period. Residents of the settlement of Willowlake River were evacuated in 1979, and residents of the settlement at Salt River expressed concern over the possible threat to their community when they saw heavy smoke drift and did not know how close the fire was. The Panel learned that in the last twelve years forest fires have also approached or threatened at least seven other communities including Inuvik, Arctic Red River, Fort Good Hope, Fort Norman, Wrigley, Fort Simpson, and Snowdrift.

Communities are of particular concern since they represent concentrations of people, their homes and properties. Highest priority is always cited for preservation of human life and community protection.

The threat is also well illustrated in the loss of communities and of life as a result of the large fires in the 1800's, the Miramichi fire in New Brunswick, Peshtigo fire in Wisconsin, and Hinckley fire in Minnesota (Brown and Davis, 1959). Similar fires in the early 1900's burned out Cochrane, Matheson and Haileybury in Northern Ontario (McClement 1969).

Almost all of the communities in this forested region are located in flammable settings. In some, such as Yellowknife, forest fuels are fairly sparse and large areas of urban development result in a hazard which is relatively low. In many others, however, such as Fort Smith, Wrigley, Fort Norman, Norman Wells, Fort Good Hope, and Fort Liard the forest not only comes to the community but is part of it. The threats to these communities from large fires moving in to them is very real.

Most have Community Fire Departments, usually operated on a volunteer basis, and some with a full-time Fire Chief. Firefighting equipment commonly consists of a pump-tanker truck and hose. While these may be adequate for most structural fires or small fires surface fuels, they are not adequate to offer protection from advancing large fires. From a forest fire standpoint community protection is best effected through a combination of three approaches — a fire-

fighting capability, a program of fire prevention, and a program of fuels management to reduce flammability and fire intensity.

The fire control aspects are discussed elsewhere in this report. Fire prevention is also discussed elsewhere. The major concern is hold-over man-caused fires which could spread quickly in spring before green-up. The particular concern about man-caused fires is that they occur primarily around communities.

The approach to community protection through fuels management is a relatively recent and important innovation. Treatments generally involve a combination of cleared fuel breaks, removing concentrations of flammable surface fuels, and thinning and pruning in forest stands. The aim is to space trees to bring crown fires to the ground, and to lower the quantity of surface fuel to reduce fire intensity to make defensive action a possibility. With planning the work can be done in a progressive and efficient manner which can help to keep the attractiveness of the forested setting.

We understand that a number of Northwest Territories communities were surveyed for possible fuels management treatments by a consultant a few years ago. We have not seen the reports, but suggest that they could form the basis for some rational, productive activities. To our knowledge no fuels management work has been done except in response to active threats. The manual prepared by Yukon Lands and Forest Service (1977) provides some excellent guidelines.

Evacuation plans should also be discussed within communities to provide a greater awareness of the threat and to lay the groundwork for orderly removal of residents should it ever become necessary.

9.4.2 Lodges, Tourism and Recreation

Lodges are located in isolated areas, usually associated with sport fishing opportunities. The physical threat of fire to lodge buildings was brought out in both representations and briefs. The Forest Service attempts to provide a measure of protection to these facilities. However, since they are in scattered remote locations and usually located within flammable forest types, the level of protection could probably never be as high as desired. Regardless of Forest Service capabilities, which should not be diminished, it would be prudent to encourage lodge owners to increasingly share a measure of the protection responsibility, as indeed many are doing now. Some aspects such as fuels management treatments around lodge buildings and encouragement of fire prevention among staff and guests are ones which could be undertaken by lodge owners. Technical information and advice should be made available by the Forest Service.

Because the lodges are in scattered locations and operate during the fire season there should be an opportunity to enlist the help of the people thus occupied at least for initial attack on easily-reached fires. This point was made by Plummer (1980) in his submission. As he puts it "We have a very large firefighting capability manpower, etc. and we have used it in the past to put out many lightning strikes close to our lodges. It is my opinion the Government should provide willing organizations such as us with fire fighting equipment, pump, hoses, on loan basis during the summer month". This idea has merit. In addition, lodge owners might operate small weather stations and radio in daily readings. Lodge guests would likely be interested in the records as well.

There was a mixed reaction by lodge owners and others in the tourism-recreation business to the effect of fire on scenic or visual quality. Plummer, for example, states "tourists come to the Northwest Territories for total experience and a burned over area around a lodge would surely weaken the repeat business prospects." Others such as Clarke (1979) in his submission on behalf of the Travel Industry Association states "fire has been an integral part of the eco-

system of the boreal forest probably since the beginning of the forest . . . The beauty of the burn and its value should be highly publicized." Others during public meetings commented that fishing was the main attraction to lodge visitors, but that photography and enjoyment of nature also ranked high. These comments suggest that protection of green areas around lodges, at least, is important. Allowing that fire is a natural part of the boreal forest ecosystem, the question of "acceptability" of fire may depend particularly on fire size and extent in these areas. On the positive side, interpretation of fires and the role of fire could provide an experience-enriching activity for lodge visitors.

Visual amenity in travel along roads and rivers will also be affected by fire size and extent. It has been suggested that some river edge is normally protected from most fires as a result of change in slope, relative humidity, and vegetation. If that is the case, river travellers may not be affected as greatly as road travellers.

No representations were made to the Panel by big game outfitters. Most operate later in the season in the western mountains so would not as likely be directly affected by fires. The indirect consequences on the game species most pursued do not appear to be too adverse, and may be beneficial. These species include dall sheep, moose, grizzly and black bear, and woodland caribou. The effect on the woodland caribou which range into alpine tundra is not mentioned in literature which we could find. We would have to assume no major concerns in that particular area.

9.5 Cabins

Numerous cabins used by hunters and trappers as base camps and line camps are scattered throughout the region. The buildings themselves represent a capital value reflecting the labour and materials put into them, and the equipment stored within. Although the majority of hunters and trappers appear to use cabins, we understand that a number of Bands commonly use portable tent camps to allow rapid shifting of activity in response to changes in caribou movements, area productivity for furs, and changes in demand for fur species.

It was frequently pointed out to us that in order to be useful, cabins had to be within green areas capable of producing meat and fur. In assessing protection strategy the value of both should be considered. This aspect is also discussed later.

Unwritten Forest Service policy includes cabins among those resources to be protected. However, because of the scattered distribution and limited availability of aircraft the level of protection received is often not as great as would be liked. As with lodges, cabin owners should be encouraged to undertake some fuels management around their buildings. When new cabins are being located, some thought of defensibility from fire should also be considered. Locations such as edges of waterbodies downwind of the direction of major fire travel, on clear points in lakes and within stands of lower flammability such as poplar or younger conifers, are generally safer.

9.5.1 Power Generation Systems, Communications and Mining

These installations are important in maintaining community amenities, as well as for their economic contributions. A high degree of protection from fire has been provided, and should continue. Interruptions in power supply and communications can be critical and are unacceptable. The situation along power transmission lines is one into which we have not been able to look. If the clearing along the line is sufficiently wide and fuels sparse it may be of relatively minor consequence if fire actually burned across the line. This may be a

point to consider in view of the great difficulty of protecting a narrow strip in an area of extensive fuels.

Fuels management treatment around microwave sites and other communications relay stations can be a cost-effective treatment in view of their point-specific nature, reducing or eliminating requirements for expensive fire control action in isolated locations. This should be a practice required by the Forest Service.

Power and transmission lines pose a particular problem. They represent long, narrow high-value strips, and particularly vulnerable to fire since wooden poles are commonly used. Their length through flammable fuels makes them difficult and costly to protect. Initial attack action is necessary, along with selected follow-up action as needed. Burning out from cleared rights of way is a defensive measure which can be used. In the longer term gradual replacement of wooden poles with steel pylons, and fuels treatments on the rights of way would make the lines less vulnerable to fire and thus easier to protect.

Some concerns were expressed over the possibility of intentional wildfire use to clear land to enhance mineral exploration. This point was addressed by Daniels (1980) on behalf of the Northwest Territories Chamber of Mines. He indicates that modern methods of mineral exploration use electronic and magnetic devices to locate mineral showings, along with chemical analysis of sediments along watercourses and of water from underground sources. In fact, he points out that the mining industry finds fires a general detriment to exploration activities. Lost time through fires or heavy smoke drift, threat of loss of expensive equipment much of which is not insurable, and threats to camps or mine facilities are all major concerns. Staking of claims requires cutting of boundary lines and placing of wooden boundary markers, both of which may be lost because of fire. Visual amenity and recreation opportunities are also important in attracting men and their families to move to areas near the mine sites.

These comments suggest that location of mining camps and exploration activities are points which should be made known to the Forest Service as part of pre-fire planning so that these values, too, may be considered in fire strategy planning.

Similarly to lodges and cabins, the mining industry should be encouraged to locate camps and installations in locations which are reasonably defensible from fire, and then made fire resistant through fuels management.

9.5.2 Highways and Travel

Highways have been identified as a high priority facility for protection. Even though the roads and most associated structures are fire-resistant in themselves, there are important reasons for maintaining a higher level of protection.

The possibilities of man-caused fires starting along highways or other routes are higher than elsewhere. Fires along highways can interfere with travel temporarily through the presence of fire itself or heavy smoke drift. Fatalities have occurred on some provincial highways as a result of obscured vision due to heavy smoke, from ground fires nearby.

Many campgrounds are located along highways. These are commonly located in sites of unique or distinctive character which lend themselves to a quality experience. Since these prime sites are so few in number, it is important to protect them and their surroundings.

Road access invariably increases the value of the land through which they pass, since the land and the products from them are made more readily accessible. In the natural resources field this particularly applies to timber producing possibilities and trapping chances. These higher values must be recognized in developing the fire plan.

Fire could affect the railroads serving Hay River and Pine Point in a physical way by burning ties and wooden trestles. Fires are commonly more frequent along railroad grades, too, as a result of carbon exhaust from diesel locomotives, and occasionally from faulty brake shoes.

Interference to air travel has occurred as a result of heavy smoke drift and reduced visibility. This was the case on many days during the 1979 fire season. In fact, the Fort Smith airport was closed to scheduled aircraft for several days. However, much of the smoke originated from areas outside the Northwest Territories jurisdiction, and such events will undoubtedly occur at future times.

Chapter 10 Socio-Economic Impacts of Wildfire

10.1 Introduction

Because of the timing of the Panel's appointment and the brief time period allowed for our review, it has not been possible to determine the physical or economic effects of the major fires that occurred in 1979. The Panel was appointed on November 1, 1979 by which time winter had arrived in the North and snow was on the ground, making it impossible even to make cursory estimates of fire intensity. Since our final report was required by March 31, 1980, we were also unable to determine the first-year impacts of fire on trapping and hunting. In any event, the full impacts of fire on vegetation, habitat, hunting and trapping can only be determined through study of recovery rates over a period of years.

The social, economic and cultural impacts of wildfire from which policy guidelines will emerge should be based on anticipated biological consequences of fire over time. These implications have been discussed, and the lack of data outlined suggest one clear forest fire management objective for the Northwest Territories. The Forest Service should co-ordinate the compilation of accurate records of the many agencies involved in the immediate impacts of wildfires on valuable forest attributes and their recovery rates following fires of different intensity, size, season of burns and periodicity. Samples from areas burned in 1979 should be used to start this program. Some fairly long range studies of fire effects may be required.

Many of the values-at-risk such as watershed protection, wildlife and recreation are very difficult to measure. They are not marketed. Even the market value of standing timber is suspect as an indicator of its marginal worth. The following discussion of timber, country food, and furbearer values is offered as a background from which policy objectives and guidelines for forest fire management may be developed.

10.2 Timber

The Northwest Territories Grade Stamping Agency (1979) shows the present sawmill industry as follows.

MILL	LOCATION	PROJECTED PRODUCTION (thousand board feet)
Gudiet Forest Products	Fort Smith	250
Conrad Plamondon	Fort Smith	250
Slave River Sawmill	Fort Resolution	4,000
Patterson Enterprises	Hay River	2,500
Ken Kimble	Fort Providence	500
Anderson Mills	Fort Simpson	500
Fred Sorenson	Grand View (Inuvik)	500
Total		9,100

In addition to these commercial sawmills there are five community mills which are used intermittently for producing lumber for local use at Jean Marie River, Wrigley, Arctic Red River, Fort Franklin and Fort McPherson. The total production for all mills in 1978-1979 is estimated to be almost 9 million board feet. In addition, recorded production of fuel wood, poles and building logs throughout the forested area was about 3 000 cunits, representing 14% of the total wood harvested.

About 10% of the lumber required for use in the Northwest Territories is supplied by local mills while 90% is imported. At the

same time over 60% of the lumber produced in Northwest Territories is shipped outside, mainly through Edmonton. The Northwest Territories Grade Stamping Agency believes that it may be assumed that a market exists for all the lumber which Northwest Territories sawmills could produce. The value of the 1979 production is estimated at \$1.75 million, of which more than 50% would have been expended for labour. The Manecon study indicates that work of 510-590 man-months were provided. Improvements in marketing and product presentation could provide the local Northwest Territories market with fifty per cent of its requirements.

Although market values do exist for standing timber they may not be accurate reflections of worth. The market value of standing timber in Canada is often a price administratively set by the Crown. A price once set is often politically very difficult to increase.

In other instances the price of standing timber, or stumpage, is calculated periodically as a percentage of market value of finished products such as newsprint. Although an improvement, these values still reflect traditional administrative pricing. A third technique is the residual value, or "what's left over," approach. Here the value of standing timber is calculated by working back from the market price of a finished product, like lumber, subtracting manufacturing costs and profit margins for each stage of the manufacturing process. If there is anything left over it is assigned as the value of standing timber.

None of these methods reflect the costs of producing or of protecting the standing timber. This is understandable since Canada until recently has been in a surplus timber supply situation. As a consequence, timber has been evaluated and marketed by the Crown in the same way that non-renewable resource stocks of minerals have been evaluated. The principal pricing criterion for natural resources by Canadian governments seems to have been the attraction of industrial development for the primary employment, and the secondary and service industries that industrial development fosters.

This seems to be the situation in the Northwest Territories where the stumpage price of standing timber has been minimal for years. The point to bear in mind, however, is the potential economic and social benefits that could derive from exploitation of the limited stocks of standing timber in the Northwest Territories. Since sawlog-sized trees may take 150 years to grow and since there are very few areas where commercial timber exists at all, the existing stands are in effect non-renewable resources — except that they, and all the development potential they represent, are susceptible to destruction by fire. This condition has never been considered in determining the level of protection from fire that should be accorded to mature timber stands in the Northwest Territories. The mature forests there are "perishable non-renewable resources" and as such require a high protection priority.

A sawtimber inventory of the Slave River Forest Management Unit was completed in 1978. The management unit covers a narrow band along the Slave River from the Alberta border at Fort Smith to the Slave River Delta at Great Slave Lake. Mature white spruce volumes of 141.2 million board feet (mmbf) were measured, of which 3.2 mmbf were harvested in 1978/79, primarily to serve a sawmill at Fort Resolution. Small amounts, less than 250 thousand board feet were sawn by each of two other sawmills in the Fort Smith area.

Sawmills at Fort Resolution have operated intermittently since the 1840's. In recent times, there were no operations between the mid-1950's and 1965 when the Territorial Government re-established a mill there. It operated a few years, ceased again, and has now operated each year since 1974-75. Operation of the mill is reported to have had a major impact on the community by providing virtually the only wage employment opportunity. Otherwise the settlement is dependent on social welfare and furs for cash income. In 1978 the Federal and Territorial Governments invested over \$750 - 000 in the mill operation to maintain and create job opportunities.

As Lagimodiere (1978) has reported, the cost of social assistance would need to increase drastically if the \$300 000 of sawmill income were removed from the community. He suggested further that should the mill close, hunters and trappers would lose much of their ability to outfit themselves for those pursuits, with consequent reductions in fur income and provision of country food.

The Panel was informed during our public meetings that the operation of the sawmill at Fort Resolution has had a significant impact on community viability, the self-esteem of the employees, and the general social conditions in the settlement, all confirming Lagimodiere's findings.

Figure 10.1, is taken from Lagimodiere's report. It shows the apparent decline in welfare payments in Fort Resolution resulting from operation of the sawmill. It also shows the income related to the sawmill and the increase in fur trapping income that seemed to accompany, perhaps stimulated by, the cash income from sawmilling. Probably a large proportion of the concomitant increase in income from fur sales has been related to a coincidental increase in fur prices. The fact remains, however, that cash is required to undertake a hunting and trapping lifestyle each fall. Indeed, as Berger (1977) has pointed out, the average cash outlay per trapper is higher than the apparent average cash return. This suggests that there is a high personal satisfaction return from pursuing the traditional lifestyle.

In 1971 in the Slave Lake Valley some 6.25 mmbf of merchantable timber were destroyed by fire at Long Island, near Fort Resolution. In 1979, 41.6 mmbf, more than 31% of the total merchantable and potentially merchantable timber were burned further upstream in the Brule Point and Grand Detour areas. An area between these two burns, known as Point Ennuyeuse and surroundings contains about 40 mmbf of timber currently looked at to supply the Fort Resolution mill until 1988/89. If this timber were to be lost the implication is that the mill would close down with a loss of some 35 jobs, returning the community virtually to welfare status.

If we are correct in considering sawlog-size timber as a perishable non-renewable resource, and recognizing that there is no alternative source of timber for the sawmill at Fort Resolution, or for other sawmills that might be built in the future we begin to get a different understanding of the potential worth of the timber. It seems to us that in these unique circumstances the loss caused by wildfire is not merely the administratively set stumpage value of standing timber. It is the present worth of the annual stream of future returns from lumber production lost, plus the difficult-to-measure social and cultural benefits that would also be lost because of mill closure, or the lost opportunity to build and operate a second mill because the stock of non-renewable timber had been diminished by fire.

We have not attempted to quantify this stream of benefits foregone as a result of the 1979 fires, since many of the social and cultural benefits ascribed to the sawmill at Fort Resolution cannot be quantified. Roughly speaking the mill provides about 30 man-years of employment per year while producing about 3 mmbf of lumber. The 1979 fires in the Slave River Forest Management Unit cost the economy a potential of about 400 man-years of employment sometime in the future.

10.3 Country Food

The existing state of knowledge concerning the caribou does not indicate severe economic consequences yet from forest fire experience in the Northwest Territories. As has been noted from earlier studies the average annual rates of burning within the caribou winter range seem to have been in the order of 1% or less. This burning rate in southern areas is reasonably conducive to production of suitable caribou habitat, that is, a fire periodicity of about 100 years. Periodicity of up to 150 years appears optimum.

An important unknown is the probable impact of very large and intense fires on caribou migration patterns. It is possible that very large fires would deflect migrating herds and possibly prevent them from reaching other areas of prime winter range. On the caribou range east of Fort Smith more than 885 000 ha (2.2 million ac.) were burned in 1979 alone as a number of lightning-caused fires burned together to create a very large burned area in the Northwest Territories, Alberta and Saskatchewan. In the same portion of the range other very large fires had burned several years previously. This has created a situation where approximately 36% of a 39 000 km² (15 000 sq. mi.) block of winter range has been rendered unsuitable for caribou for the next 20 to 50 years. In that area the average annual rate of burn over the last 12 years has been 3%.

The Panel has already recommended that field studies be undertaken in this area to determine the implications of these large fires on the migrations of the Beverly herd. We are pleased that our suggestions have helped to support field surveys that are already underway.

In sections of the winter caribou range that have experienced severe burning over a short period, the Panel believes that the residual unburned portions acquire significantly greater importance to sustain caribou that do migrate through the area rather than avoid the area altogether. Although some ecologists (Rowe *et al.* 1975) tend to favour allowing fire to play its natural role in the caribou range, others (Kershaw and Rouse, 1976) have expressed concerns about large-scale fires in that they affect not only the immediate environment, but will lead to increased desiccation of areas downwind. The Panel believes that it would be desirable to extend protection into these remaining green areas at least until such time as the burned over areas have begun to be useful again as caribou habitat, or the rate of burn falls within acceptable limits.

There are two principal socio-economic questions. The first is whether or not the overall amount of winter range available to the caribou is a limiting factor to their survival. Both our perusal of the literature and discussions with scientists indicate that it is not yet a factor limiting current population levels. It could become a factor, however, if decisions were made to increase the size of the Beverly or other herds, or if the higher rates of burn in some identified areas was to continue.

The second factor relates to the cost of hunting. If large fires within traditional hunting areas deflect migration patterns away from settlements, then the hunters would incur additional costs to locate the herd and retrieve their meat supplies. Although it is too soon to be definitive respecting the large fires that occurred in 1979 east of Fort Smith, the available evidence suggests that the Beverly herd did take a more easterly route on the southward migration this winter.

On the other hand, migration routes may vary from year to year for no apparent reason. It would be difficult then to isolate fire as the cause of migration pattern change. Furthermore, a change in migration patterns away from one community may bring the herd closer to another, resulting in offsetting hunting cost reductions to the hunters of the latter communities. This seems to have been the case in 1979. We understand that several communities in northern Saskatchewan and Manitoba experienced better than average hunts this year.

A partially offsetting factor to fires in caribou range is that moose populations may increase somewhat in the burned areas to form a partial substitute for caribou meat for some 30 years. However, on these ranges the weight of moose per unit area is substantially less than that of caribou. There may be lowland sites within the Shield country, and areas in the Great Plains region where moose populations may be increased through site management techniques.

Fort Resolution: Community Income — Selected Sources

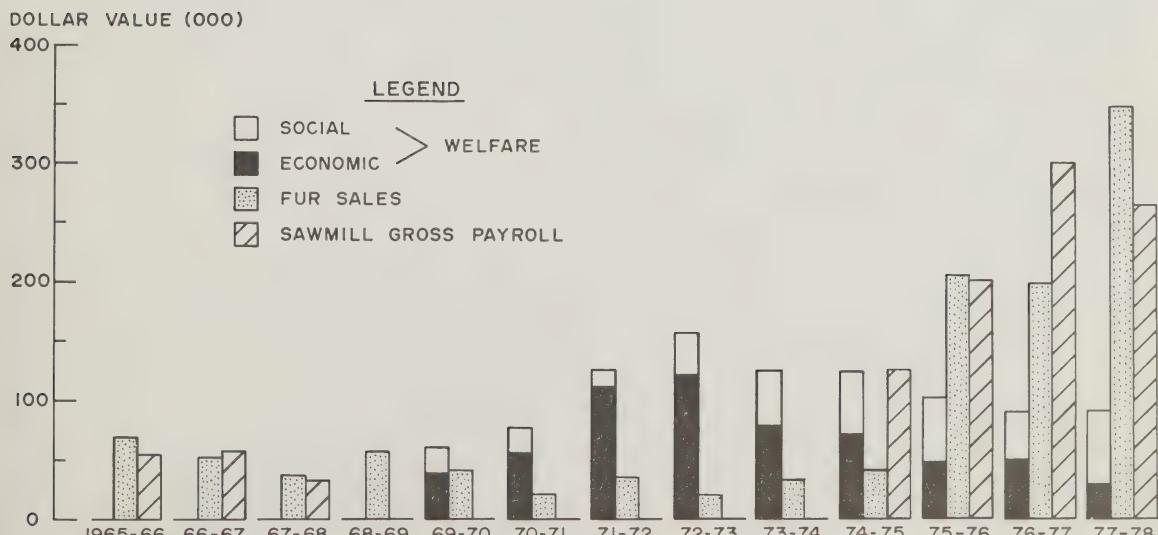


Figure 10.1: Fort Resolution Community Income.

This would only be possible where species such as willow and poplar could be encouraged.

10.4 Furbearers

The evidence that we have been able to gather suggests that overall furbearer populations are enhanced by a mosaic of vegetation — habitat types. The importance of "edge" conditions between mature forests and recently burned over areas with young pioneer vegetation has been stressed to us by scientists as beneficial to wildlife in general.

Evidence given to the Berger Commission parallel comments we received from wildlife management personnel in the Northwest Territories. It appears that fur yields in the Northwest Territories could be higher than they are now if more efficient trapping effort were applied.

In most areas of the Northwest Territories trappers move from area to area over a sequence of years, leaving areas "fallow" so that populations may recover from trapping harvests. It is not likely that a moderate amount of fire in these regions causes a noticeable effect on fur harvests, except possibly in particularly lightning-prone areas or through the occasional very large fire. In our review of the situation we have not been able to identify any significant decreases in

fur harvests that could be identified as fire-related, except in the Fort Smith area. The loss of hunting and trapping areas in other locales has been in large measure overcome by the hunter/trapper absorbing greater costs of travel to reach new hunting and trapping areas.

In the Fort Smith area, however, a registered trapline system was introduced in the 1940's. Here the trappers have invested considerable time in developing trails, building cabins, and learning how to manage the furbearer populations. We have been informed that the trading price for a registered trapline in the Fort Smith area may be as much as \$20 000. In 1977-78 the reported income of Fort Smith trappers amounted to \$260 350. There were 130 registered trappers of whom 62 earned more than \$600 from fur sales. Fifteen earned more than \$4 000.

The very large fires to the east of Fort Smith in 1979 appear to have virtually destroyed the 1979/80 furbearer harvest on at least eight traplines as shown in Figure 10.2. In addition, the productivity of a number of other lines has been seriously impaired.

If further plans to assign registered traplines are developed, it appears prudent to reserve part of the area allocated and left open. This would make it easier to assist re-establishment of a trapper whose line burned over. Some degree of flexibility in assignment of areas must be maintained in expectation that fires will occur.

We are unable to estimate the annual harvest losses in future years that should be ascribed to the 1979 fires, but we expect them

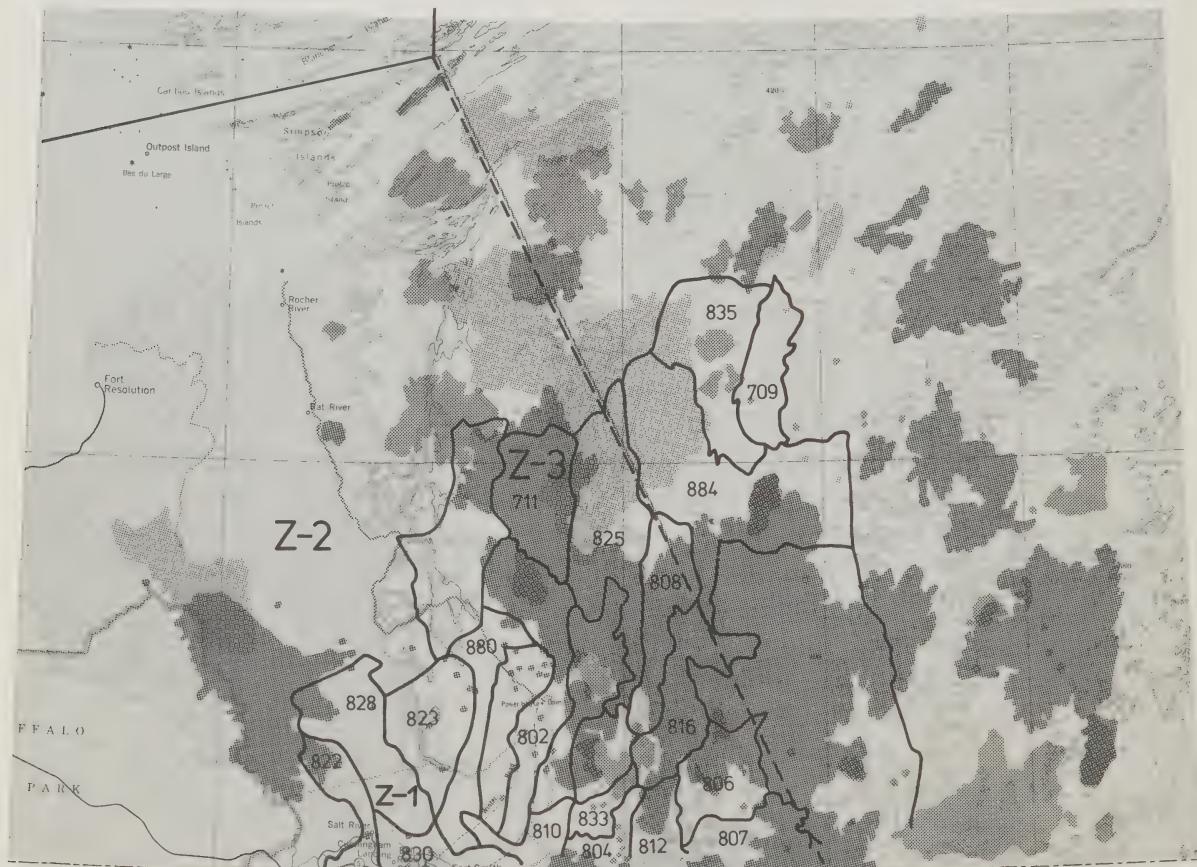


Figure 10.2: Trapping areas and recent burns east of Fort Smith

to be significant because of the very large size of the area burned which will result in long repopulation processes for most species. Fluctuating fur prices makes estimating of future values hazardous.

Data received from the Hunters and Trappers Association of Fort Smith indicates that capital values alone destroyed by fires in 1979 may have exceeded \$75 000, made up of the following components: trapping equipment, \$38 025; cabins, \$22 577; household goods, \$9 895; clothing, \$3 855; and food supplies, \$1 178.

The values listed above do not include trapline improvements that were destroyed; nor do they include any indication of anticipated reductions in trapping revenues over a period of years following the fires. The latter cannot be foretold, although personal interviews with a number of the affected trappers indicated that they were having very little success in the first season following the fires.

Changes in future years' productivity may be difficult to ascribe directly to fire. The most significant species from an economic point of view over the last several years has been lynx. Lynx populations are directly related to the highly cyclical populations of hare. It would be difficult to determine the proportion of hare population change attributable to fire and the proportion attributed to normal cycles of hare populations. Further, this ratio may change several years in the future when the benefits of post fire vegetation may make some traplines more lucrative than they were in the past.

An opportunity exists for the GNWT Wildlife Service to work with the affected trappers and others in areas that were not burned to develop first-hand knowledge of fire impacts on trapping success rates of various species.

We have been advised that the approximate cost to an individual who wishes to become a trapper is about \$12 000. This would provide a main cabin, one or two line cabins, a snowmobile, boat and motor, traps, and the labour to cut traplines.

If all the trappers and trapper groups who were burned out or whose lines were significantly damaged could be assigned new trapping areas of similar harvesting potential, an estimate of damage to trapping would be the number of traplines involved, multiplied by the estimated trapline establishment cost of \$12 000. At least 10 traplines would fall in this category for a total estimated loss of \$120 000. To this total would have to be added a figure for the present worth of additional travel costs to and from Fort Smith, should such be incurred. If no alternative trapping areas can be located for these 10 trappers and trapper groups, much more serious loss has been incurred — the loss of a lifestyle.

Some general indicators of the immediate economic impact of reduced trapping success in 1979-1980 in the Fort Smith area were reported to us. Snowmobile sales were reported to be down by some 60% in late January, snowmobile repairs were down about 30%, dry goods sales were lower.

Pelt prices vary so dramatically that it would be most difficult to base fire control needs on economic criteria. For example, in 1972 the average price of a lynx pelt was \$27.00. By 1974-75 it was \$80.00 and in 1978-79 it had reached \$305.00, with individual pelts bringing upward of \$500.00. We understand that by late December, 1979 the market for long hair fur had changed again and some lynx pelts could not be disposed of at auctions.

At present the Government of the Northwest Territories employs a Trappers and Hunters Disaster Compensation Program that will pay trappers up to a maximum of \$3 000 should they sustain financial losses as a result of forest fires or severe storms. To be eligible, a resident trapper must hold a General Hunting Licence and receive at least half his total income from trapping and/or hunting. Following the 1979 fires 26 claims were submitted averaging \$4 265. The Government may wish to review this compensation program to ensure that the current ceiling does not cause relative hardship to the full time commercial trapper. It may be desirable to include a factor for trapline improvements lost.

The limited information we have been able to glean through a

sub-contract (Bunnell), and most of it from other areas, suggests that populations of water-based species such as beaver, muskrat and mink should recover within 5 or 6 years or so of fire. Indeed juvenile vegetation should be conducive to relatively high population levels of these species.

Red fox and weasel populations may be expected to recover in up to 10 years, but squirrel and marten seem to require mature forests for at least part of their habitat needs and may require 25 or more years to repopulate a burned area.

As well as fire intensity, overall fire size may be a major factor in determining the period of years required for different species to re-establish on a burned area. As previously mentioned large fires may disturb caribou migrations as well. The Panel does not know what an "acceptable" fire size might be in the northern boreal forests. There is certainly no simple answer, but it is a question which should be discussed.

10.5 Lifestyle

As indicated in Table 10.1 fur constitutes an apparently insignificant 4% of the value of resource exports from the Northwest Territories. Yet when examined in combination with country food harvest and on a community basis rather than a global Territorial basis, an entirely different picture emerges.

We have adopted this approach for two reasons. First, the forested area of the Northwest Territories is vast and the communities stand out as discrete centres of activity. Second, the lifestyles found in the communities divide dramatically between dependence on the land and the wage dominated society.

Table 10.1: Value of Resource Exports
of Northwest Territories

	\$ million, adjusted per CPI for Edmonton to 1979 \$							Compound growth rate %
	1967	1970	1973	1976	1977	Average ¹		
Mineral	44	102.0	112.6	158.9	197.8	118.6		16.2
Oil & Gas	5.3	6.8	14.3	12.9	12.0	10.3		8.5
Tourism	5.3	10.2	10.8	16.0	18.3	12.1		13.2
Fur Exports	1.8	2.2	5.5	5.7	4.6	3.9		9.8
Handicrafts	3.3	3.0	3.5	10.6	11.0	33.7		12.8
	59.6	102.0	146.7	204.1	243.7	151.2		15.1

¹ Average of 10 years export value.

Source: GWT; Economic Development Dept.

The Panel recognizes and cautions that there is no meaningful way to translate a chosen lifestyle into monetary terms. Cultural values of a society are those of the spirit, the heart, the soul. Nevertheless, it should prove useful to attempt to review the significance of natural resource harvests at the community level.

In a sub-contracted study Manecon Ltd. has depicted compo-

inent sources of community income from wage employment, welfare receipts, trapping and hunting. Data were sparse and considerable estimating was required. The rates of return of income tax form were found to vary from 31% to 93%, leaving no way to determine incomes earned by those who did not file returns.

Available statistics on wildlife harvests are based on returns from holders of General Hunting Licences. The returns from hunters varied from 45% to 79% between 1968-1973 as Berger (*op. cit.*) reported. Studies have shown (Berger, *op. cit.*) that kills that are reported tend to be understated. Berger's methods were adopted here to incorporate a reporting error factor and to allow for the higher protein value of wild meat compared to domestic beef. A value of \$3.00 per pound was used to value the output. The results of these calculations are shown in Table 10.2. In 1975-76 the total imputed value of country food amounted to \$8 million.

To show more clearly the relative significance of country food and fur income in the more traditional communities, they have been arranged in descending order of native population concentration as shown in Table 2.1 earlier. It is interesting to note that all the predominantly traditional settlements have native populations of at least 85%, while those communities that support a wage economy have less than 30% native populations. The only community that does not fit into either category is Fort Simpson which recently began a transition from traditional to wage economy in anticipation of a pipeline construction project.

One significant indicator of the sharp differences between the two categories of communities is the number and the proportion of private sources of employment available. This is shown in Table 10.3. In the predominantly native communities there are few sources of wage employment. This underlines the importance of the surrounding natural resources for these settlements.

Figures 10.3 — 10.6 show the estimated total incomes by components for two predominantly native communities, Fort Good Hope and Snowdrift, and two predominantly white communities, Inuvik and Yellowknife.

Although the data were sparse, the relative importance of the imputed value of country food in the traditional communities compared to the wage-economy towns is clear. It must be borne in mind that even in the wage-dominated towns, Fort Smith for example, there are important elements of the population who stoutly retain traditional values and continue to live off the land.

It can be noted from the graphs that income from fur sales is a small component of the total, even in the traditional communities. It is important to bear in mind, however, that this small component is cash income, an income essential to provide for the weapons, ammunition, traps, and supplies. That the hunter/trapper requires to follow his chosen occupation.

During their visits to the communities in question, the Panel members were impressed with the unique values expressed and demonstrated in the small native settlements. While all human values are inherently subjective, the people of the North seem to place greater stress on elements of their cultural heritage than do southerners, probably because they see their culture threatened by an invading white wage economy.

We submit that the southerners who must decide how best to apportion a limited budget must bear in mind that from 35-40% of the population of the forested area of the Northwest Territories are native northerners. On a geographic basis, the natives dominate the area, with the whites largely confined to urban enclaves such as Yellowknife, Inuvik, and Hay River, and Fort Smith.

It was put to us by those living on the land, that allowing the forests to burn was equivalent to an urban dweller having his house burn down. The land's ability to produce country foods, fur and fuel was referred to as the natives' interest-bearing bank account. A common admonishment heard was that when man takes out the

resources of creation (minerals and oil), man should return something to creation, protection from fire.

10.6 Landsat Imagery Use in Fire Management

While visual interpretation of standard Landsat imagery can be used to gain an inexpensive estimate of area burned by fire, the standard imagery has limitations. There is considerable distortion in the images that can lead to significant errors. It is very difficult to distinguish fires of the current year from those of the previous year. Burned areas, rock and some bog types may be hard to separate. It is not possible to estimate accurately the amount of unburned area within a fire's perimeter.

Through the excellent cooperation of the Canadian Forestry Service and the Canada Centre of Remote Sensing in Ottawa we were able to arrange for a trial use of the latest techniques of imagery interpretation to study forest fire damage in the Northwest Territories. Dr. Peter Kourtz and Mr. Bernard Todd of the Canadian Forestry Service experimented with sophisticated techniques to determine whether or not accurate separate descriptions could be made of areas burned in 1979 and 1978, areas partially burned, and areas left unburned. The area selected for the study was in the caribou range east of Fort Smith where the very large fire, known as SM2 occurred in 1979. The study area covered approximately 37 000 km² (14,300 sq. mi.) between longitudes 112 degrees W and 109 degrees W and between latitudes 60 degrees N to 60 degrees 30 minutes N.

Kourtz used geometrically corrected tapes to remove as much distortion as possible from the imagery. The process also yields a product that permits almost an exact overlay of imagery onto a Universal Transverse Mercator map.

By using temporal overlays from imagery taken before the 1979 fire season and after he found it possible to distinguish between the areas of the 1979 fires and fires of previous years. He employed the Taylor method of principal component enhancement to bring out as much detail as possible concerning burn intensity and perimeter location. Figure 10.7 shows an example of the colour enhanced overlays. It shows about one-eighth of the study area (long. 111 degrees W — 110 degrees W; lat. 60 degrees N — 60 degrees 30 minutes N). A portion of the circular Pilot Lake is evident at the left margin of the picture. The dark blue-green area bordering Pilot Lake represents the area that burned there in 1978. The area of reddish-brown colour indicates areas burned in 1979. It is notable that even at the scale shown it is possible to identify strips or "stringers" of apparently unburned "green" areas within the burn. The area of another 1978 fire is outlined between two major portions of 1979 fires in the top-central portion of the figure. In this particular image, Kourtz estimated that at least 21.2% of the area burned intensely in 1979, 6.5% was partially burned, and 9.4% burned in 1978.

Unfortunately, Kourtz was unable to obtain suitable clear imagery from a date following the 1979 fire season. The latest date for which cloud-free imagery was available was August 8, and considerable spreading of the fires occurred after that time. He was, therefore, unable to estimate the entire area burned by fire SM2 as hoped. Ability to interpret the imagery was hampered by a lack of "ground truth" information. He reported to us that he was uncertain of the separation of burnt moss conditions, unburnt moss, and bare rock areas.

Produced from the study were a series of 20'x 20' prints of the colour enhanced overlays. The Panel has turned these over to the Forest Service. We recommend that the Forest Service co-operate with Dr. Kourtz in the completion of his work by providing the nec-

Table 10.2: Average Annual Value and Weight of Food Produced by Community

Average Annual Value of Food Produced by Community¹
(thousands of 1979 dollars)

Average Annual Weight of Food Produced by Community⁽³⁾
(thousands of pounds)

	75-76	74-75	73-74	72-73	71-72	70-71	68-70	68-69	67-66	66-67	75-76	74-75	73-74	72-73	71-72	70-71	69-70	68-69	67-68	66-67
182	787	706	619	614	418	408	590	883	533	Aklavik	38	164	147	129	128	87	85	123	184	111
10	n/a	29	14	5	19	24	67	77	48	Arctic Red River	2	n/a	6	3	1	4	5	14	16	10
22	144	149	317	5	53	34	192	178	312	Fort Franklin	46	30	31	66	1	11	7	40	37	65
293	134	619	648	763	1 080	566	470	782	499	Fort Good Hope	61	28	129	135	159	225	118	98	163	104
298	682	341	528	470	610	355	691	979	485	Fort McPherson	62	142	71	110	98	127	74	144	204	101
202	202	96	72	158	139	398	442	466	Fort Norman	42	42	20	15	82	33 ²	29 ²	83 ²	92 ²	97 ²	
230	355	403	250	201	259	182	211	418	163	Inuvik	48	74	84	52	42	54	38	44	87	34
77	77	29	58	38	n/a	n/a	n/a	n/a	n/a	Norman Wells	16	6	6	12	n/a	n/a	n/a	n/a	n/a	n/a
125	77	144	206	230	278	317	389	307	341	Fort Liard	26	16	30	43	48	58	66	81	64	71
38	43	58	96	38	144	149	240	302	187	Fort Providence	8	9	12	20	8	30	31	50	63	39
293	1 032	475	427	144	389	293	187	158	533	Fort Resolution	61	215	99	89	30	81	61	39	33	111
331	259	19	254	427	552	686	619	586	643	Fort Simpson	69	54	4	53	89	115	143	129	122	134
82	504	528	336	393	562	418	413	456	288	Fort Smith	17	105	110	70	82	117	87	86	95	60
211	322	173	115	178	168	250	264	269	278	Hay River	44	67	36	24	37	35	52	55	56	58
3 518	2 611	4 008	2 458	1 910	3 019	2 827	3 350	3 211	3 514	Fort Rae	733	544	835	512	398	629	589	698	669	732
331	422	91	134	235	643	845	427	552	408	Reliance/Showdift	69	88	19	28	49	134	176	89	115	85
1 306	984	898	754	672	926	960	912	667	557	Yellowknife	272	205	187	157	140	193	200	170	139	116
n/a	38	34	43	173	82	134	91	101	110	Nahanni Butte	n/a	8	7	9	36	17	28	19	21	23
48	14	n/a	24	n/a	n/a	n/a	n/a	n/a	n/a	Trout Lake	10	3	n/a	5	n/a	n/a	n/a	n/a	n/a	
158	62	62	134	163	235	206	68	168	134	Wrigley	33	13	13	28	34	49	43	35	36	28
7 954	8 749	8 862	7 487	9 595	8 793	9 679	10 536	9 499			1 657	1 823	1 846	1 580	1 388	1 999	1 832	2 017	2 196	1 979

(1) Values were determined by (1) adjusting food production figures by a protein correction factor for big game ('Gross Imputed Values of Country Foods', Berger, op. cit.) and (2) applying a value of \$3.00 per pound to the adjusted food production figures. ("Community Food Basket Relative Costs", NWT Statistical Profile — June 1979, NWT Planning and Resource Development Division.

(2) Includes Fort Norman and Norman Wells.

(3) Weights determined from Kill Statistics Derived from General Hunting Licence Returns; GNWT, Fish and Wildlife Service. These figures were adjusted by (1) "Estimates of Error in officially Recorded Big Game and Bird Harvest; * Northern Frontier, Northern Homeland, * Berger 1977 and (2) 'Average Edible Weight (in pounds) Per Animal', Berger, op. cit. For bearers and fish production are not included in the above figures.

essary "ground truthing" information so that the accuracy of the imagery interpretation can be checked.

The Panel feels that use of Landsat imagery with the sophisticated interpretive techniques now available should be explored further by the Forest Service. We suggest that the Forest Service consult with the Canadian Forest Service and the Canada Centre for Remote Sensing to see if it would be feasible to use Landsat imagery not only to determine areas burned annually and to estimate their intensity, but also to monitor vegetation recovery following fire.

Table 10.3: Approximate Number of Employers

By Community¹

1979

Distribution To Private and Institutional Facilities

Community	Private ²	Institutional ^{3,4}
Group A		
Fort Good Hope	4	8
Arctic Red River	1	3
Fort Liard	6	8
Wrigley	2	6
Fort Franklin	2	6
Snowdrift	2	6
Fort McPherson	4	9
Fort Norman	5	9
Rae-Edzo	5	6
Aklavik	8	11
Fort Providence	6	10
Fort Resolution	8	10
Group Average	4.4	8.5
Group B		
Fort Simpson	40	15
Group Average	40.0	15.0
Group C		
Inuvik	200	20
Fort Smith	64	32
Hay River	235	20
Norman Wells	29	8
Yellowknife	500	50
Enterprise	7	2
Group Average	172.5	22.0

Column Average Per Group as Percentage of Group Average

Group A	34%	66%
Group B	73%	27%
Group C	89%	11%

1. Source: Northwest Telecommunications - 1979 Telephone Directory

2. Includes only apparently privately owned businesses.

3. Includes: All levels of government, school, hospitals, RCMP, Religious institutions, etc.

4. Each level of government is counted only once per community. Government agencies are counted separately.

Community Profile
Showing Relative Importance of Traditional Industry in Community Income

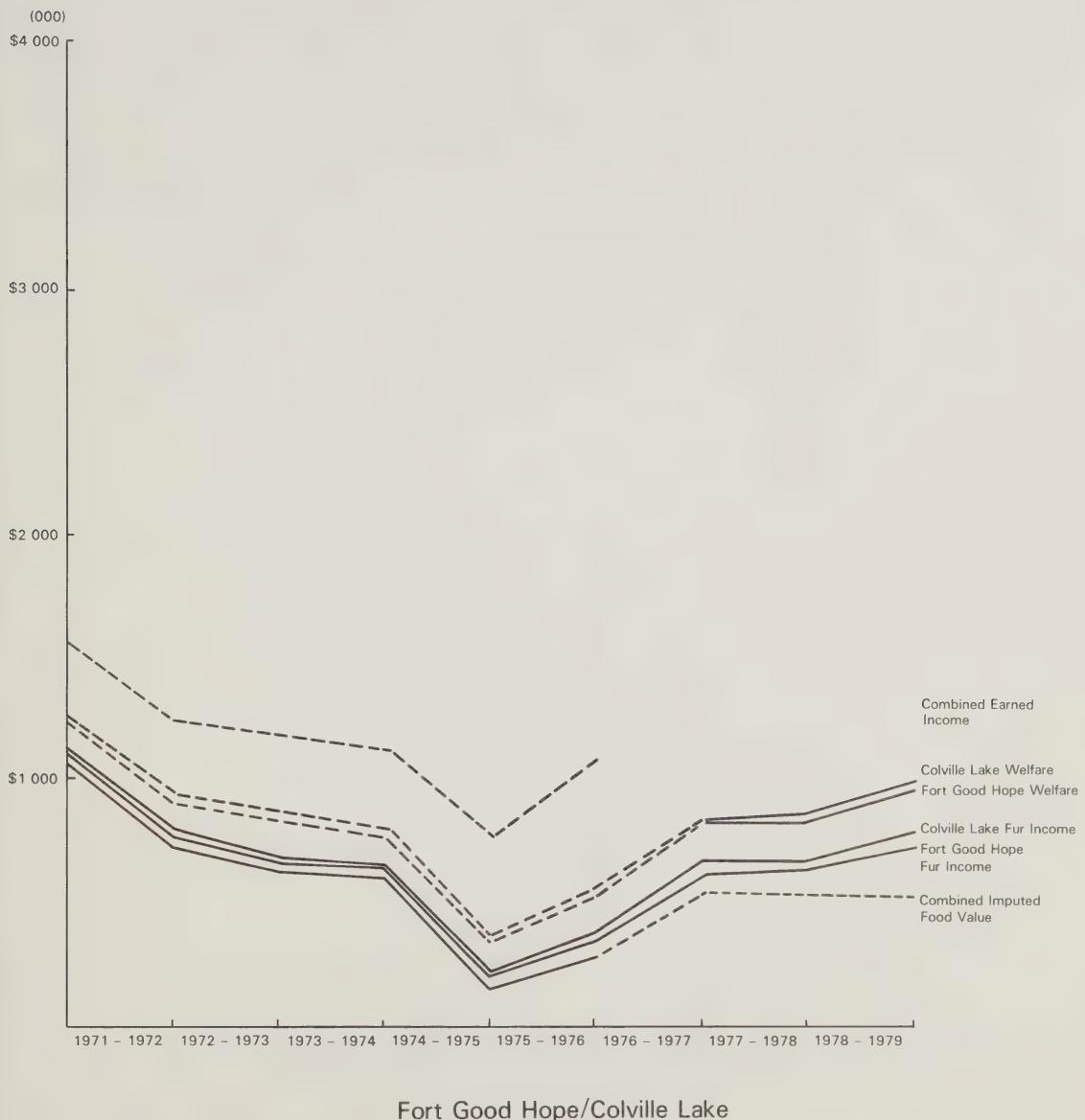


Figure 10.3: Community Profile — Fort Good Hope/Colville Lake.

Community Profile

Showing Relative Importance of Traditional Industry in Community Income

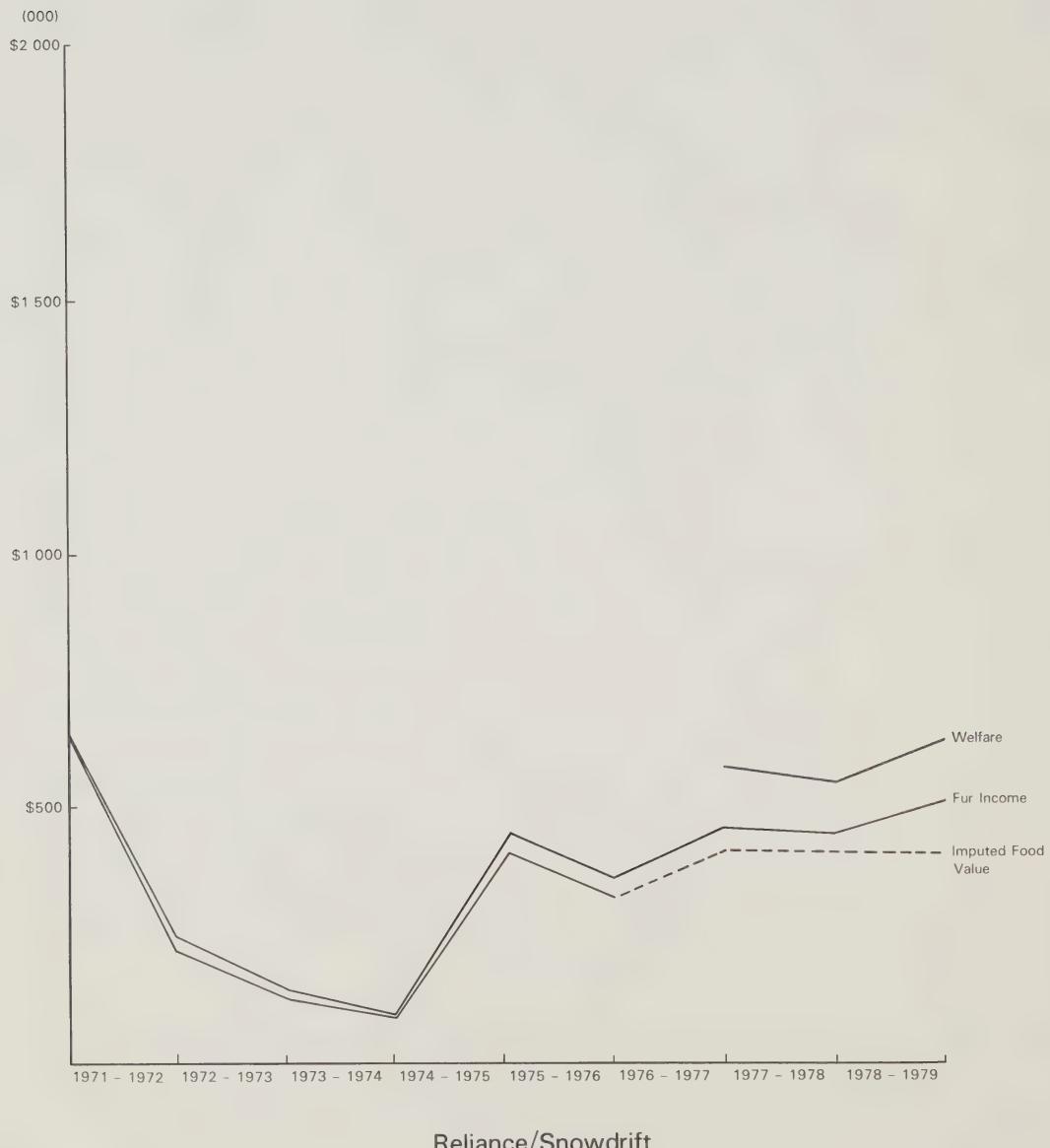


Figure 10.4: Community Profile — Reliance/Snowdrift.

Community Profile
Showing Relative Importance of Traditional Industry in Community Income

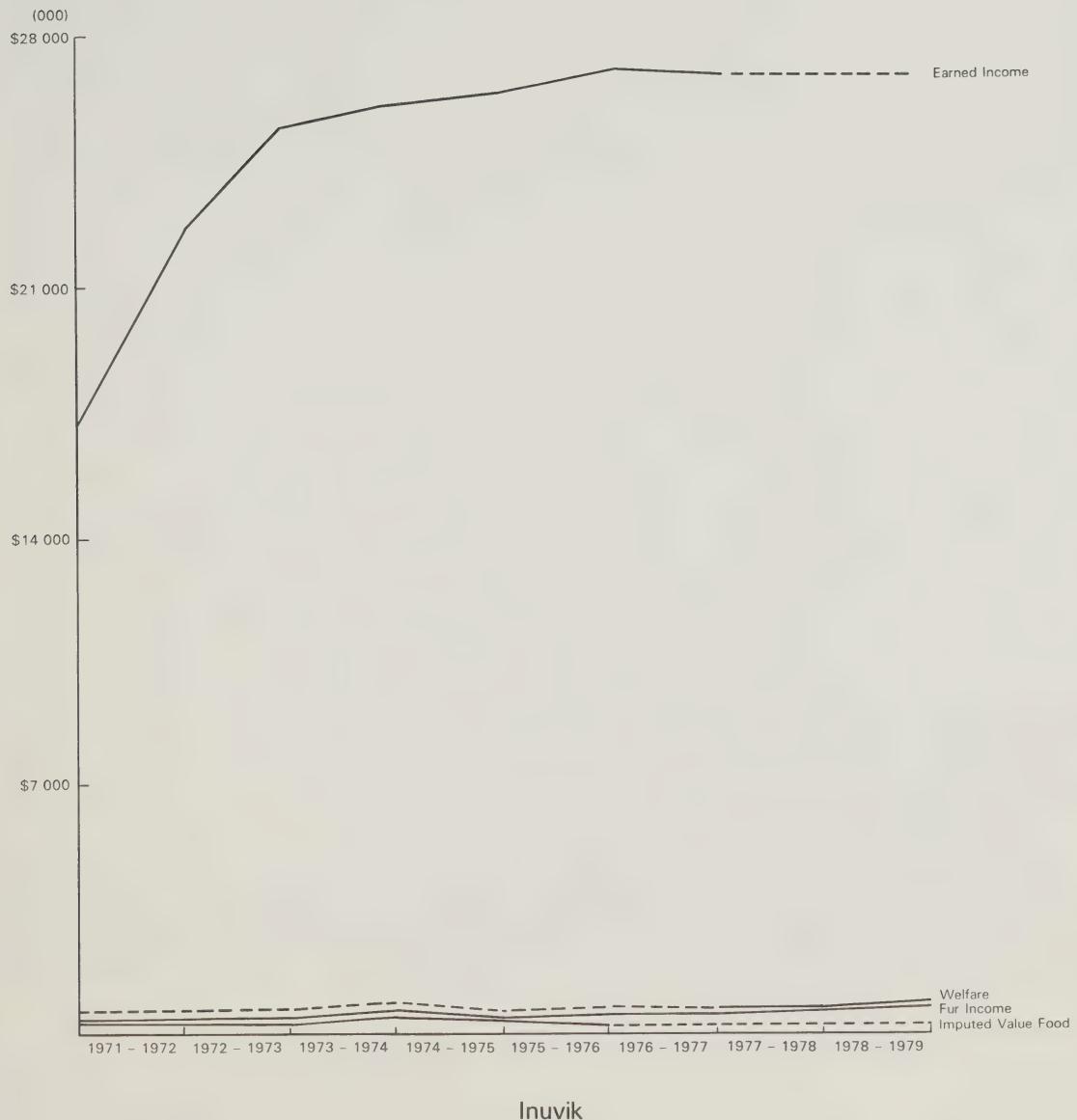


Figure 10.5: Community Profile — Inuvik.

Community Profile
Showing Relative Importance of Traditional Industry in Community Income

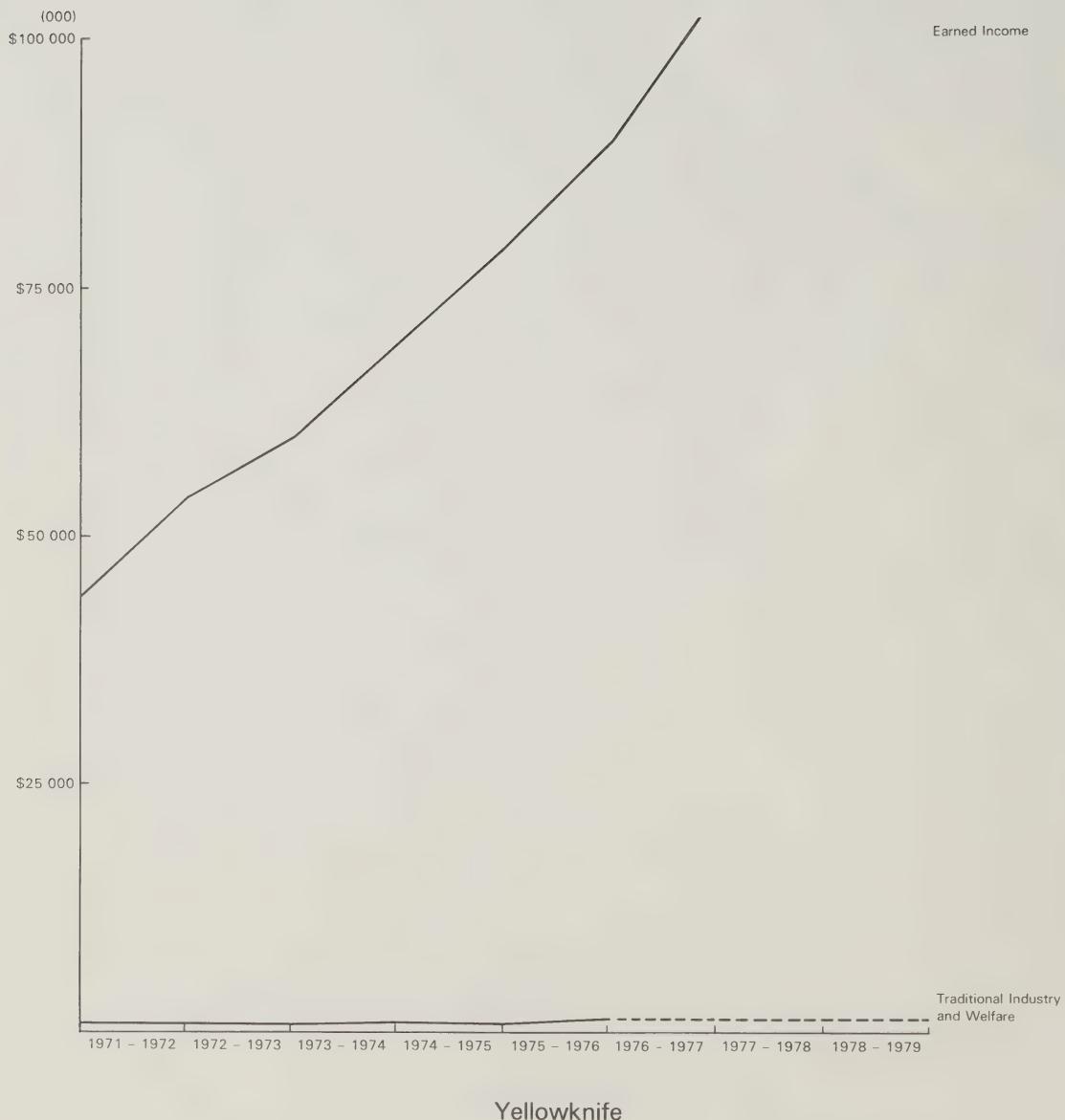
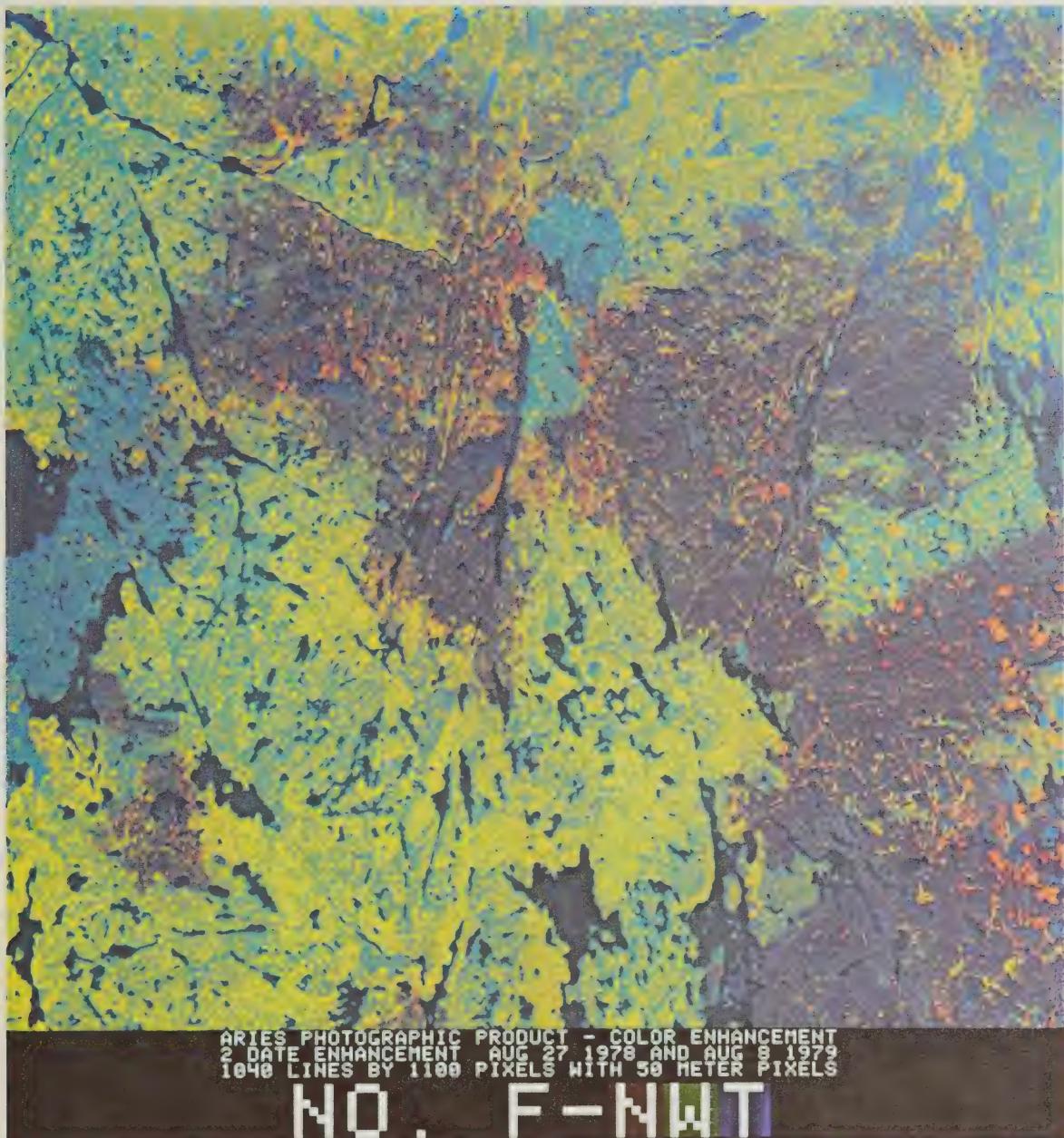


Figure 10.6: Community Profile — Yellowknife



ARIES PHOTOGRAPHIC PRODUCT - COLOR ENHANCEMENT
2 DATE ENHANCEMENT AUG 27 1978 AND AUG 9 1979
1040 LINES BY 1100 PIXELS WITH 50 METER PIXELS

NO. F-NWT

Figure 10.7: Colour-enhanced satellite imagery covering part of the caribou range east of Fort Smith.

Chapter 11 A Basis for Fire Management Policy in the Northwest Territories

11.1 Current Policies

The principal objective of the Federal Government's fire management policy is "to reduce wildfire damages to a level consistent with the present and future needs of the people".² The policies adopted to meet this objective have been based on a Priority Zone concept since 1967. This concept allows variation in fire control action and expenditures in relation to the values-at-risk, taking into account the sparse population in the Northwest Territories and its centres of activity, the location, accessibility and level of use of the resources subject to fire damage.

There are four significant elements to the policy: the criteria used for zone determination and delineation; the fire management objectives for each zone; the action guidelines for each zone; and the way these policies are actually implemented.

Priority Zone 1 identifies the main communities and their immediate environs as areas to receive the most intensive protection to safeguard life and property. Those areas within approximately 32 km (20 miles) of communities larger than 500 people and within 16 km (10 miles) of settlements with 25-500 people are included in this Zone.

The fire control objective for Zone 1 is clear: "to control and extinguish those fires which threaten or could threaten life and property associated directly with cities, towns or settlements." Sub-objectives include a maximum fire size of 25 ha, and maximum fire suppression costs of \$5 000 per fire, implying a capability for very rapid detection and initial attack on new fires.

Priority Zone 2 includes small communities of less than 25 people, producing mines and tourist lodges and their immediate surroundings within some 3.25 km (2 miles). Also included are narrow strips of land on either side of transmission and communications lines, as well as major highways.

The natural resources included in Priority Zone 2 are accessible merchantable timber and young stands on highly productive sites within 32 km (20 miles) of existing roads.

Fire control objectives for Priority Zone 2 are much less clear than those for Zone 1. The Department's manual states that: "fires may be actioned provided ample justification exists based on assessments of manpower and equipment availability, operational feasibility, anticipated short and long term effects of fire — and the alternative uses of limited presuppression and suppression funds." When fires in Zone 2 are actioned, the sub-objectives include a maximum fire size of 200 ha (500 ac.) and a maximum control cost of \$10 000.

It is in Priority Zone 3 that the majority of natural resource value criteria are found. Included are critical or high-value habitat for wildlife, important trapping areas, and high-quality timber sites with potentially merchantable timber which are less accessible than those included in Zone 2. Unique recreation areas, areas of high erosion potential, and domestic watersheds also receive Zone 3 rating.

The fire management objective for Zone 3 is the same as that for Zone 2, except that it is recognized that fires in this less accessible Zone may not be detected and acted on as quickly as those in Zones 1 and 2. Average cost limits per fire have been set at a higher \$15 000. The Manual also notes that firefighting efforts in Zone 3 may have to be reduced during periods of high and extreme burning conditions so that Zones 1 and 2 may receive appropriate attention.

Zone 4 includes all that forest land and tundra not included in the first three Priority Zones. It is a non-protected area. Fires occurring in Zone 4 are only fought if they directly threaten relatively high value resources in the other zones.

The "action guidelines" contained in the Manual outline spend-

²Canada, DIAND. Fire Management in the Northwest Territories, a Comprehensive Manual for Managers of Renewable Resources, 1979, p. 2A — 2.

ing authority delegation to district staff who initiate action on fires. In Zones 1 and 2 the District Protection Officer is expected to take immediate control action up to a maximum cost of \$8 000 per fire. He must seek the authority of Head of Fire Control for the Northwest Territories for authorization of costs up to \$50 000. Additional authority, if required would have to be given by the Director of the Northern Affairs Program in Yellowknife.

In Zone 3, the District Protection Officer can only initiate action to \$8 000 for fires that threaten life or property or threaten to spread into Zones 1 or 2. This authority would be restricted to a ceiling of only \$3 000 depending on the proportion of the total Northwest Territories fire suppression budget that had been spent before a particular Zone 3 fire occurred. Based on averages from experience in past seasons, the restriction applies if 30% of the budget has been spent by the end of June, 65% by the end of July or 90% by the end of August.

In Zone 4, the "action guidelines" allow initial attack action up to a cost of only \$30 000 on fires that threaten Zones 1 or 2.

Although these financial management constraints are laudable, they appear to have been used to make fire management objectives and policies secondary to financial management objectives.

11.2 Changing Policies

Although a Priority Zone concept was adopted for the Northwest Territories in 1967, it was not until a disastrous fire season was experienced in 1971 that a formalized policy was written for implementation in 1973.³ A major increase in funding was provided the same year for new equipment and manpower needed to meet the policy objectives.

Since that time there have been several changes in policy that the Panel reviewed with some apprehension. The apprehension deepened when we examined how the latest version of the fire management policy was actually implemented. The level of resource protection has been lessened to the point where we do not believe the Department is able to meet its principal aim of reducing wildfire damages to a level consistent with the present and future needs of the people.

The key changes have been in the fire control objectives. For Priority Zone 1 the policy has been reduced from one requiring control and extinguishment of all fires to extinguishment of "those fires which threaten life and property associated directly with communities."

In Priority Zone 2, the policy has changed from "all fires will be actioned and extinguished" to an objective that states that "fires may be actioned (emphasis ours) provided ample justification exists"

For Priority Zone 3 the policy has similarly been modified from "all fires will be actioned and extinguished" to a maximum expenditure of \$50 000 to "fires may be actioned provided ample justification exists"

In 1973, the objective in Zone 4 called for an initial attack on up to 20 fires per year in an attempt to limit the annual area burned to something approaching that which pertained from lightning-caused fires before prospectors and others began using the area. In 1979, the policy was to minimize fire control costs and action only those fires that threatened values in Zones 1, 2, or 3.

It could be argued that the more general fire control objectives now in place for Zones 2 and 3 allow fire management decisions based on natural resource values-at-risk and on the potential impact of fire in maintaining the natural ecological mosaics in the Northwest Territories. But this has not been the case. The Policy Manual contains no guidelines based on natural resource management — only financial management guidelines.

Along with the erosion of policy objectives there have been

changes in the total areas included in each Priority Zone and in the total area protected.

Northwest Territories Fire Management Zone Areas (km²)

YEAR	ZONE 1	ZONE 2	ZONE 3	TOTAL
1968	35 600	155 500	68 100	259 200
1975	36 200	105 800	201 200	343 100
1976	33 000	130 800	59 500	223 300
1977	46 600	120 100	0	166 700
1979	46 600	120 100	0	166 700

*Sources: DIAND files for 1968, 1975, 1976. DIAND Fire Management Staff, Fort Smith for 1979. Figures rounded to nearest 100 km

The principal reasons given for decreasing protected areas were the history of fire control overexpenditures and the general financial restraint program instituted by the Government in the mid-70's. This was indicated in a number of documents including a letter from the Assistant Deputy Minister of Northern Affairs to the President of the Indian Brotherhood of the Northwest Territories, dated December 1, 1976. In that letter it was stated that: "The main reason for decreasing the size of the protected area in 1976 was to minimize the overexpenditures of the fire suppression budget, and to adhere to the economic restraints imposed by the Government."

The most significant change occurred in 1977. Although the fire management staff indicated to us that there were 58 200 km² classified as Priority Zone 3, a departmental memorandum stated: "During the period 1972 to 1975 significant overexpenditures of fire control budgets occurred. As a result of these overexpenditures it was decided to reclassify Priority Zone 3 as an unprotected zone with the exception of taking action on fires which could threaten higher Priority Zones."⁴ This decision placed the Zone 3 areas in the unprotected Zone 4 category.

By this stage then the priority of the fire management objectives had been largely overtaken by the priorities of fiscal management.

The Panel is not competent to comment on the Government's rationing of its scarce resources among the many competing programs demanded by Canadians. We do believe, however, that a clearer understanding should have been developed with the people of the Northwest Territories so that their expectations would have been more in line with the Forest Service's ability to produce. We are aware that the Forest Service attempted consultations with native communities seeking their advice to delineate their areas of prime interest for trapping and hunting. Some communities did not respond at all, others only half-heartedly gave the Forest Service full cooperation.

We are also aware that the Forest Service has requested that natural resource management agencies advise the Service of their requirements for fire control. To date, the responses have not been sufficiently sophisticated to provide support for the Forest Service's budgetary arguments.

³DIAND, Northern Economic Development Branch, Fire Management in the Yukon and Northwest Territories, April, 1973.

⁴J.A. McQueen, Regional Manager, Northern Affairs Program to G.T. Glazier, Assistant Regional Director, Northern Affairs Program. "Cost of Fire Protection — Zones I, II, and III, Sept. 14, 1977."

The lesson is obvious. There is an urgent need for the users of the land and the managers of natural resources to consult and advise the Forest Service on their requirements. It is one thing for citizens to cry out that Government has failed them in its services. It is quite another matter when some of these same groups have given only half-hearted cooperation to the government agency that seeks to respond to the people it serves.

11.3 Toward a New Fire Management Policy

11.3.1 A Logic Framework

Wildfire management is but one facet of forest management, and as such its policies must be devised to meet the objectives of forest management. Similarly the objectives of forest management programs should be complementary to and supportive of broader land use objectives. These in turn should support overall goals of government for the social and economic well-being of a region from both national and provincial/territorial points of view.

The Panel has attempted to review this hierarchy of objectives and policies against which the current forest fire management policies may be judged and upon which modifications may be proposed. This has proved to be a difficult task. In several important areas we were unable to find statements of objectives or concepts of resource management that could serve in building a framework of objectives that a forest fire management policy should be designed to meet. In some instances legislation and regulations concerning specific aspects of natural resource management have provided insights into unwritten policies. We have also borrowed from recently published reports commissioned by the Federal Government, and have tried to incorporate philosophies and concepts that were expressed to us at public meetings in northern communities and by natural resource experts in various fields.

11.3.2 Broad Governmental Objectives

At the national level a "Statement of the Government of Canada on Northern Development in the 70's" was presented to the Standing Committee of the House of Commons on Indian Affairs and Northern Development in 1972. The relevant objectives specified at that time were:

1. "To provide for a higher standard of living, quality of life and equality of opportunity for northern residents by methods which are compatible with their own preferences and aspirations."
2. "To maintain and enhance the northern environment with due consideration to economic and social development."
3. "To encourage viable economic development within regions of the Northern Territories so as to realize their potential contribution to the national economy and the national well-being of Canadians."
4. "To realize the potential contribution of the Northern Territories to the social and cultural development of Canada."
5. "To further the evolution of self-government in the North."
6. "To develop fully the leisure and recreational opportunities in the Northern Territories."

The Statement went on to list the Government's priorities for action, tempered by certain constraints, including the Government's other priorities and limitations on Government resources. The third priority for action, following programs for social improvement and

environmental protection was: "to encourage and stimulate the development of renewable resources, light industry and tourism, particularly those which create jobs and economic activities for native northerners."

The Statement also referred to the importance of maintaining opportunities for northern natives to follow their traditional pursuits of hunting, trapping and fishing and, most of all, to preserve the right of natives to choose which aspects of their cultural heritage shall be preserved for the future.

Closely related to the Federal Government's objectives and strategies for northern development are policy guidelines of the Government of the Northwest Territories, including:

1. The increase in employment of native people.
2. Preservation of northern lifestyles.
3. The increase in participation and responsibility of native people within the institutions of government.

The rights of the Indian bands to hunt, trap and fish within the forested area of the Northwest Territories were preserved with the signing of Treaties 8 and 11 in 1899 and 1921 respectively. The Panel has assumed, therefore, that the objectives of the two governments relate not only to rights to hunt and trap, but to the opportunity to retain this lifestyle as a viable alternative or supplement to the wage economy.

Of direct significance to an evolving forest fire management policy are the government's objectives of providing for a higher quality of life, increasing employment opportunities for northern natives, developing the renewable resource sector, protecting the options of northerners to maintain traditional lifestyles, and deeper involvement of native northerners in the decision-making processes. The Panel has endeavoured to incorporate these objectives in our final recommendations.

Obviously, the most basic objective of wildfire management must be the protection of the people and the communities in which they live. The communities of the North are isolated centres set directly in the forest, often in high risk situations.

More evidence suggesting the overall policies of Federal Government comes from negotiation of land claims with native groups. Although no agreements have been reached with either the Dene Nation or the Metis Association of the Northwest Territories respecting native land claims, an agreement in principle has been reached with the Committee for Original People's Entitlement. The geographic area involved does not include forested areas of the Northwest Territories, but the agreement does include principles relating to renewable resources that indicate the Federal Government's position respecting renewable resources in the North. One of the basic principles of the agreement calls for the protection and preservation of the Arctic wildlife environment and its biological productivity. Presumably this basic principle would apply to the Federal Government's position on the forested areas of the Northwest Territories. If so, it could have significant impact on forest fire management policies.

These basic points are developed into formal recommendations in the final chapter of the report.

11.3.3 Objectives for Natural Resources Management Agencies

Moving from the more general social and economic objectives of governments to specific natural resources, there appear to be few clues from existing land use policies to guide the development of forest fire management objectives and policies. While the Federal Government retains control over land use and allocation, except within communities, it does not seem to have defined a comprehensive pol-

icy framework to guide decisions among often competing land uses.

There are, however, Acts and Regulations to protect the quality of the environment when specific land use activities are proposed. The Territorial Land Use Regulations provide for a permit system for use of explosives, heavy vehicles, drilling, campsites, fuel caches, land clearing or earthmoving machinery. Presumably these regulations could be made to apply to forest fire control activities such as fire line construction and the establishment and maintenance of fuel caches and firefighting camps.

Other natural resource legislation and regulations relating to water resource management, migratory birds, fisheries, oil, gas and mineral exploration and development, tourism, national parks, historic sites, etc. all have implications for land use management. Two current water resource management projects may be cited as examples. Under the Canada Water Act an agreement between the Federal Government, the Governments of British Columbia, Alberta, and Saskatchewan has led to studies of the water and related resources of the Mackenzie River watershed. The recommendations of these studies, if implemented would influence future land uses in such sensitive areas as along the Slave River and in the Slave River Delta. A second Canada Water Act agreement between Canada and the Government of the Northwest Territories has lead to a flood risk mapping program of flood-prone areas in the Territories. The results of this program will yield land use restrictions in the identified flood plains.

The unfortunate fact remains, however, that there is no overall conceptual or philosophical framework of land use objectives or policies. There is developmental legislation and conservational legislation administered by a plethora of Federal and Territorial agencies. Worse, there seems to be no effective interagency body to coordinate and integrate the objectives and policies of these agencies, except in the field of environmental quality.

The Environmental Assessment and Review Process, administered by the Federal Department of Environment, is one coordinated program designed to ensure that all major development proposals have minimized impact on the natural environment.

There remains, the void of comprehensive framework of land use goals and objectives to guide the development of forest fire management policies. Although beyond our terms of reference, the Panel recommends that the Department of Indian Affairs and Northern Development give the solution to this problem the highest priority.

The Panel has even been unable to find evidence of forest management objectives for the Northwest Territories, except with respect to fire management. Here the broad objective, as previously described is "to reduce wildfire damage to a level consistent with the present and future needs of the people to ensure the continuation of their enjoyment and use the resources". This is a fine objective, but it raises more questions than it answers. What are these resources? How are they used? How are they likely to be used in the future? How are they impacted by fire in different fuel types, seasons, intensities, and fire sizes? Without some sort of definitive guidelines from the managers of the other natural resources of the land, it is difficult to make this general statement of fire management meaningful through the implementation of defined policies.

The Fish and Wildlife Service of the Northwest Territories Department of Renewable Resources stands out as one agency that has spelled out goals, objectives and policy guidelines to direct its activities. These will be significant to the development of wildfire management requirements.

The goals of that Service are⁵:

1. "To maintain productive populations of native mammals, birds and fish in their natural habitats."
2. "To encourage the wise use of wildlife within the limits of sustained yield to help meet the requirements of residuals of the Northwest Territories."
3. "To encourage the conservation of fish and wildlife habitat through co-ordination and co-operation with environmental management agencies."
4. "To promote the aesthetic values of fish and wildlife for the enjoyment of all people."
5. "To encourage the participation of residents in the proper management and use of fish and wildlife resources through education and by supporting organizations representing subsistence and combined uses."

To meet these goals, the Fish and Wildlife Service has launched programs to gather data on wildlife populations and distributions, the impact of wildlife harvesting, and other information necessary to develop written management policies for the major species, including moose, barren ground caribou and furbearers. Such information will be vital to the forest fire manager in determining requirements for fire control.

The Fish and Wildlife Service administers a number of programs designed specifically to assist those engaged in traditional lifestyles on the land. These programs directly support the Territorial Government's policy guidelines to increase employment of native people and to preserve northern lifestyles. Similarly they help fulfill the Federal Government's priority for maintaining opportunities for northern natives to follow their traditional pursuits.

One of the programs is the Outpost Camp Program which provides for financial assistance to families or groups of less than 60 people who wish to leave settled communities and establish themselves in isolated locations and endeavor to live off the land by hunting, trapping, and fishing. In return for this assistance the recipients forego claims for social welfare assistance. Currently 39 camps including a total of 435 people receive assistance. There is obviously a critical need for coordination between those responsible for administering the Outpost Camp Program with those responsible for fire control. The fire management officials should be advised at least a year ahead of impending Outpost Camp developments so that they may determine appropriate changes in their fire management plans and budgets.

The Service also administers a Trappers Incentive Grant Program designed to counteract the effects of fluctuating fur prices in relation to the rising costs of goods and services required by the trapper.

Trappers Assistance Loans are also available to assist with annual initial expenses for food, trapping equipment or transportation to trapping areas.

It should also be noted that under the Special Rural Development Agreement between Canada and the Government of the Northwest Territories funding can be made available to help a would-be trapper purchase necessary equipment.

The Fish and Wildlife Service has played a major role in assisting the organization of more than 50 Hunters and Trappers Associations in the Northwest Territories. Approximately 25 of these are in areas south of the treeline. A major function of the "HTA's" is to serve as a coordinating point of contact with the people, to advise the Fish and Wildlife Service and other governmental agencies of problems and opportunities confronting those engaged in the traditional pursuits, and assisting the Fish and Wildlife Service in implementing assistance programs for hunters and trappers. A significant feature of the Hunters and Trappers Associations is that they bring together individuals of different ancestry, Dene, Metis, Inuit and white, to consider and speak on common issues.

From this summary it is evident that efforts are in hand to assist in maintaining and enhancing opportunities for those who wish to retain or return to the traditional ways of life on the land. Once

⁵Government of the Northwest Territories, Fish and Wildlife Service. Goals, Objectives, and Policies. 1977.

the Fish and Wildlife Service has completed studies of big game and fur bearer habitats and have discussed their ensuing wildlife management proposals with the HTA's, it will be able to advise the Department of Indian and Northern Affairs more specifically on fire control requirements.

The demonstrated degree of support for those who wish to follow traditional lifestyles supports the Panel's view that important habitats for caribou and furbearers should receive at least some protection from large-scale fires, at least until the Fish and Wildlife Service has been able to define appropriate requirements. The Panel feels it is important to try to prevent recurrence of very large fires on important hunting and trapping areas as occurred during 1979 on the caribou range east of Fort Smith.

11.3.4 Social, Economic and Cultural Factors

We have grouped social, economic and cultural factors together in our consideration of their influences on desirable wildfire management policy objectives and guidelines. We have found them to be inextricably related to the type of traditional economy we find in the North. This applies both with respect to the values lost through wildfire and to the significance of fire control expenditures on the maintenance of traditional lifestyles.

11.3.5 Some Development Concepts

In his report of the Mackenzie Valley Pipeline Inquiry, Mr. Justice Thomas R. Berger made several recommendations of key importance to wildfire management objectives and policies. He recommended that a ten-year moratorium on pipeline construction be imposed, and that during that period the Government should pay particular attention to developing opportunities in the renewable resources sector of the northern economy. He felt this to be of major importance so that native northerners would have alternative employment opportunities available to them and could maintain their traditional lifestyles if they wished to do so. The importance he placed on this is demonstrated by his words. He felt it "vital that development of the renewable resource sector be given priority now. If it is not strengthened and thriving by the time the pipeline is built, native people will not be able to withstand the impact of the pipeline project and all that it will entail." (Berger, 1977, p. 3)

While Berger laid great emphasis on the desirability of developing the renewable resource sector of the northern economy prior to gas pipeline construction, he also stressed the importance of native involvement in development planning if the ensuing economic activity is to nurture rather than undermine the native society and economy. He expressed the essential need of preserving the northern culture and taking advantage of it to develop the renewable resource base. Unless native northerners have a major role in decisions, he felt that the historic relationships of white domination of northern social and economic processes, with all the related social problems, would continue.

In his recent report to the Minister of Indian Affairs and Northern Development, J.W. Beaver (1979), President of the National Indian Socio-Economic Development Committee has adopted similar arguments. Observing that the dependency on government services is demoralizing and has helped to produce individual and social breakdown in Indian communities, he recommended that "the Indian bands be given the authority, responsibility, and resources to develop their own policy for the improvement of social and economic conditions in their communities." He argued that this community-

based planning and development offered the best opportunities to move in the direction of self-reliance.

Development of Indian communities must evolve, and to ensure success of the process, it must be based upon the non-material aspects of Indian culture, their indigenous 'skills, organization, and discipline' (Beaver, op. cit., p. 30). Although Beaver's report concerned the problems and opportunities of Indian reserves in the south, it seems to us that his comments have equal validity for application in native communities of the North.

Beaver's thesis directly parallels or reflects advice put forward by Schumacher (1974) in his discussion of ways and means to stimulate development in Third World countries. Declaring that the ultimate source of any wealth whatever is people, he stressed that development must "start with people and their education, organization and discipline" (p. 164), and that these essential underpinnings of development must evolve to fit changing circumstances rather than be superimposed by outsiders.

It follows that modern technology should be introduced into developing communities on an "intermediate" technology basis, a basis that maximizes work opportunities to make use of the available labour surplus, and a basis that accommodates constraints that may be present — in educational levels for example.

We believe that these development philosophies offer guidelines for wildfire management objectives and policies in the North. Furthermore, they are supportive of a number of sincere suggestions and recommendations we received during our meetings with the public, requests for community involvement in advising, in decision-making, in firefighting.

A major objective of the wildfire management program should be to involve communities in the determination of fire management policy, including the identification of priority hunting and trapping areas and the development of fire control plans that incorporate the availability of the resources of each community.

Evidence that came before the Berger Commission indicated that there were opportunities in the management, harvesting, and processing of fur and game, in logging and sawmilling, fishing, recreation and conservation. He pointed out that not only was the settlement of native land claims a prerequisite to pipeline construction, but that one of the objectives of native claims was the protection of wildlife so vital to traditional native lifestyles.

As we have pointed out earlier, evidence that we received from both public meetings in the Communities and from the scientific experts closely paralleled that heard by the Berger Commission.

Budgetary evidence available to us indicates that Mr. Justice Berger's recommendations have been considered in rather contradictory ways. On the one hand, for example, a General Development Agreement and the Interim Subsidiary Agreement under it were signed in 1979. These agreements, with an initial budget of \$3.8 million, shared by the federal departments of Indian Affairs and Northern Development and Regional Economic Expansion and the Government of the Northwest Territories, provide for important programs to begin the stimulation of the lumber, fur, tourism and country food components of the renewable resource sector. The Agreement also calls for the preparation of an overall economic development strategy for the Northwest Territories.

On the other hand, forest fire management budgets have not kept pace with inflation. The annual presuppression budgets from 1971 to 1979 are listed below. These funds are used for the operation and maintenance of the organization, covering such elements as wages for seasonal staff, equipment maintenance, and seasonal aircraft charter contracts. Following a major increase in 1972, the pre-suppression budget has not been adequate to maintain the basic strength for the Forest Service to meet its objectives, as evidenced by the shrinking Priority Zones.

In comparison, the United States Forest Service presuppression budget rose from \$5 to \$41 million in actual dollars from 1965 to

1976. Unlike the U.S. Forest Service the Northwest Territories fire organization is still in a development stage. Presuppression budget restraints have hindered the ability to provide an effective infrastructure and a reasonable level of protection from fire.

Northwest Territories Fire Presuppression Budget

Year	Budgets in Actual Dollars	Annual Budgets in Terms of 1979 Dollars
1971	717 000	1 355 130
1972	1 573 171	2 804 993
1973	1 898 000	3 182 981
1974	1 663 000	2 514 456
1975	2 055 000	2 804 296
1976	2 373 000	3 012 068
1977	2 560 000	3 008 955
1978	2 713 000	2 915 048
1979	2 969 000	2 969 000

The already limited presuppression budget has been strained further in the last year or so by new expenditures for aircraft contracts. Prior to 1978 aircraft suitable for fire service were numerous in the North. They could be chartered on a casual basis as required for firefighting, with their costs charged to the fire suppression account. Since that time there has been a sharp drop in aircraft numbers, up to 70% for helicopters, apparently due to the postponement of the Mackenzie pipeline project. To counter this situation, the Forest Service has had to hire more aircraft on a full seasonal basis and these costs must be charged to the presuppression budget.

The fire suppression budget covers actual firefighting costs. Although impossible to forecast accurately in advance because of the unknown fire occurrence situation to be encountered the following year, the fact that the suppression budget was "overexpended" in eight of the last nine years has apparently raise concern.

The term "overexpended" itself is a concern to the Panel. It suggests weaknesses in budgetary control. In fact, provincial forest fire management agencies "overspend" suppression budgets virtually every year. Since the amount required is never known in advance, a nominal sum is budgeted and provision of additional funds in response to need is understood.

Instead, the situation suggests to the Panel that the Forest Service has been unable to obtain and maintain an adequate base of equipment and manpower to meet its objectives. The weakness of the fire detection system is perhaps the most serious flaw. The lack

Territories Fire Suppression Budget

Year	Budget in Actual Dollars	Budget in 1979 Dollars	Expenditures Actual Dollars
1971	386 000	729 540	5 000 000
1972	472 000	841 584	4 889 000
1973	480 000	804 969	2 168 000
1974	493 000	745 416	826 000
1975	690 000	941 588	1 781 000
1976	690 000	875 823	849 000
1977	917 000	1 077 817	1 063 000
1978	1 068 000	1 147 538	517 000
1979	1 126 000	1 126 000	2 914 000

of available man-years even to place all the fire lookout towers in operation in 1979 simply compounded the problem.

We believe that it would be logical to consider wildfire management budgets as a part of overall development budgets. Not only do they provide for the protection of the renewable resource base, but they offer important employment and skills-development benefits for native northerners. The potential employment, training, leadership, and personal satisfaction benefits that can be made available for natives through the wildfire management program should be recognized by those setting fire management budgets and the policies for their implementation.

11.3.6 Furbearers and Country Food

The rationale frequently put forward to the Panel, and found in the literature, was that wildfire has always been a natural factor in the northern environment. Lightning-caused fires have produced the mosaic of vegetation and habitat types that exist in the North. Just as the major tree species are those that have rather unique characteristics that enable them to reproduce following wildfire, so too do the furbearers, caribou and moose adjust to the changing scene. The Panel believes that these ecological findings are basically correct in the long run, which is what the ecologists refer to in their studies.

We believe, however, that those responsible for financial management in the Federal Government may have misinterpreted the ecological scientific advice. They used it perhaps to help overcome a short term financial management problem. By adopting the principle that lightning-caused wildfire is a natural element of the environment that in the long run is at least neutral, if not beneficial, to caribou and furbearers, the decision makers seem to have neglected the needs and aspirations of the people involved. The people depend on the wildlife productivity of the land in the present and short term, as well as the long term.

At one time adoption of a "let burn" policy would have been appropriate with respect to wildlife management. In earlier days the northern natives were much more a part of the ecological system than they are today. They did not live in fixed communities but migrated with the game they depended on. But now, northerners have been encouraged to adopt southern habits and live in permanent communities. Even though they now have modern transportation available to them, aircraft and snowmobiles, they suffer great difficulties and expense in terms of both time and money if major fires occur within now traditional hunting and trapping areas — perhaps an area within 160 km (100 mi.) of their settlements.

We submit that the resource manager can no more depend on the vagaries of nature in the North than he does in the South. In the South the impacts of wildfire are controlled to meet man's needs.

We have been told (Scotter, personal communication) that the caribou herds in the western arctic will not be able to withstand the increasing hunting pressures resulting from the growing native population in the Northwest Territories. If maintenance of traditional lifestyle alternatives is an objective of the Government, it will be necessary to employ management techniques to increase caribou numbers. In this situation the availability of quality winter range may be found to be a limiting factor. Since winter range food supplies approach optimum levels in forest communities that are 50 to 75 years old (Scotter 1967, Kershaw and Rouse 1976), and decline after 150 years, it may become important to decrease the rate of fire recurrence in certain areas. As skills develop it may become important to use prescribed fire in very old stands of timber that have become of closed canopy and where the lichen beds have been suppressed by mosses.

In any event, the important point at this stage of knowledge of habitat as a limiting factor in caribou population levels is that protec-

tion from wildfire should be extended into those areas that have, in the last decade, sustained severe fires. As previously stated, the Panel recommends that until wildlife biologists have the knowledge to determine caribou range requirements, the range should receive some protection.

The Panel suggests as a starting point an "acceptable" annual area burn objective of about 1% in southern portions of the range in the Northwest Territories.

The same recommendations would apply with respect to fur bearer habitat on two grounds. First, repopulation of large burned areas may be expected to be much slower than the repopulation of small areas since the progeny of most species do not seem to migrate far from their birthplace before establishing their own territories. Second, the green areas that remain in and around heavy burned areas are not only important breeding areas to repopulate the burned areas, but they have increased value as trapping areas.

As wildfire management objectives the Panel recommends that efforts be made to prevent fire from creating large contiguous areas of recently burned over areas in prime caribou range that could deflect caribou migration or limit their winter food supplies.

11.3.7 Forests

In light of Mr. Justice Berger's recommendations for renewable resource development and the "perishable non-renewable" nature of the timber in the Slave River valley, an important objective of forest fire management in the Northwest Territories should be to provide complete protection to these stocks of timber.

We have dwelt on the forests of the Slave River valley at some length because more is known about them than the forests in the Fort Liard and other areas, and also because their harvesting and use at the two small sawmills near Fort Smith and the larger one at Fort Resolution seem to exemplify the renewable resource-based developments the Berger Commission recommended. We believe our comments respecting the Slave River Management Unit should also be applied to the other significant productive areas for timber, particularly in the southwest portion of the Northwest Territories, near Fort Liard. Road access from the south will soon be available there. The objective should be to extend full fire control to these forests.

Although the Panel was not asked to consider forest management objectives, we feel it important that the Department of Indian Affairs and Northern Development turn its attention to forest management in a much more comprehensive way than it has in the past. In addition to the obvious need to develop a data base on the timber volumes and qualities available, we believe attention should be turned to problems of reforestation, particularly in the Slave River Management Unit. The latter should involve studies of natural regeneration following the fires of 1979, selection of superior trees in remaining stands, collection and storage of seed from these superior trees, the development of a small forest tree nursery in the area, and the planting of burned areas that do not regenerate naturally.

Based on the discussion above we suggest that the following goals and objectives should be considered by the Department.

Forest Land Management Goal

To provide for the maximum continuing benefits from the integrated management of the renewable resources of forest land for the people of the Northwest Territories and Canadians in general.

Forest Land Management Objectives

1. To coordinate the development of forest land management plans through the assembly and interpretation of knowledge of the life processes of individual resource attributes and their interactions.
2. To develop a comprehensive forest land capability inventory.
3. To develop a comprehensive forest inventory of all forests in the

Northwest Territories with the productive potential of supporting local industries.

4. To encourage the harvesting and use of mature timber to provide for local needs.
5. To develop an understanding of natural regeneration processes following timber harvesting and wildfires in productive forest areas.
6. To establish a reforestation capability.
7. To reduce wildfire damages to a level consistent with the present and future needs of the people to ensure the continuation of their enjoyment and use of the resources.

We recommend adoption of the following objectives for forest wildfire management. We suggest that they must be discussed with the people of the Northwest Territories so that they may be refined to meet the needs and aspirations of the people as discussed in the final chapter of this report.

Wildfire Management Objectives

1. To protect human life and communities.
2. To protect natural resources from fire in a way that reflects and responds to the hinterland values of each community.
3. To help maintain options for northern natives to pursue their traditional lifestyle as a viable alternative.
4. To protect the perishable non-renewable and potentially commercial timber stands as a basis for economic and social development.
5. To restrict the average annual rate of burning to acceptable levels in areas that are important for trapping or caribou winter range.
6. To restrict maximum fire size in important trapping and caribou winter range to a size compatible with wildlife productivity.
7. To minimize environmental damage resulting from fire control activities.
8. To develop applications of prescribed fire as a resource management tool.
9. To use wildfire management budgets and programs to further the economic and social development programs of the Federal Government, and the Government of the Northwest Territories.
10. To involve communities in wildfire management policy decisions and the development of local wildfire management plans.
11. To provide employment, training and leadership opportunities for native northerners in wildfire management programs.
12. To employ cost-effective fire management technology designed to take advantage of the education, discipline, organizational skills and the availability of labour in northern communities.
13. To coordinate the compilation of accurate records of the immediate impacts of wildfires on valuable attributes of forest land and their rates of recovery following fires of different intensity, size, season of occurrence, and periodicity.

Chapter 12 Recommendations

12.1 Introduction

In order to manage forested lands it is essential first to have an appropriate level of ability to control fire, making it possible to exercise options and judgments. In our view there is not at present an adequate level of either control or management in the Northwest Territories.

Fire in the past has played a "natural" role in the environment, and plants and animals have adapted in some ways to it, or at least those most capable have survived. Now, however, use of the land and demands on it by man have increased, people are less nomadic, allocation of trapping areas has reduced flexibility of movement, and man is unwilling to accept the extreme vagaries of nature such as fire, floods and windstorms. Fire is of particular concern in the Northwest Territories where it is perceived to be adversely affecting opportunities necessary for maintenance of traditional activities such as hunting and living on the land.

Fire does play a renewal role in the boreal forest. Allison (1979) comments that effective fire suppression, if implemented over a large area of the Northwest Territories, would be an inadvertent ecological experiment on a scale unprecedented in North America. On the other hand, those living close to the land see fire as an undesirable force, at least in certain areas and at certain times. Certainly some fires, and large fires, will burn regardless of man's interventions. Virtually all areas will be burned at some time — some fairly frequently and some at intervals of perhaps three hundred years or more. The level of "interference" suggested in the recommendations that follow will not result in ecological monotony. Rather, our recommendations are an attempt to better balance fire effects in light of recommended forest land management objectives, the need for habitat renewal, and the needs and aspirations of the people.

Attempting to control all fires in the forested area of the Northwest Territories would be extremely expensive and virtually impossible given the resources which might be made available. However, man can affect the degree and frequency with which areas might burn, and man can set priorities for fire action based on land resource values. As previously discussed, fire action priorities must be tailored to land management objectives. Land management values must be determined in consultation with the people living closest to the land, and in consultation with other people and agency representatives who also have interest in the land. When the land resources are in demand, as at present, the values-at-risk do not permit a non-action policy to the extent which now exists. A more positive and responsive policy of fire management is in order. The managing agency must be aware of and alert to threats to resource values and must be able to keep its action options open.

In virtually all cases there will be some budgetary limits imposed. These limits should represent levels negotiated, justified on the basis of past fire experience, values to be protected and demonstrated successful and cost effective fire management programs. Not all our recommendations involve more funds. Many low-cost and no-cost actions are possible which will improve the situation.

Ideally there would now exist defined and agreed-upon land management objectives, and sufficient ecological knowledge to let us know the optimum mix of habitat types and age classes. This knowledge would make clear the degree of fire application required. In addition, there would be sufficient technical capability to effect it, and an adequate budget and organization to do it on a cost-effective basis. However, we are not in an ideal situation so need to proceed on the basis of best estimates, dialogue and willingness to learn and to change. To get any policy to work it needs to be discussed among those involved, with problems worked out cooperatively as events go along.

The intent of these recommendations is to give policy guidelines and suggest directions. In some cases we have identified specific areas which should be afforded a higher level of protection now. In

general, we have proposed conceptual approaches wherein the details should be worked out by all those particularly concerned — public and agencies.

In our view it is critically important that wildfire operations be based on natural resource management policies and criteria, and not on financial management criteria as it now is. As previously discussed, the financial management criteria currently used ensure that fire management policies will fail. Our policy recommendations in this chapter are designed to meet the objectives developed in Chapter 11.

The numerous recommendations suggest a higher level of complexity in Forest Service operations but we believe that the agency is capable of seeing this done. It is important to effect changes. It is equally important to be seen to be working towards improvement. There will be additional severe years and areas burned. However, it is important in intervening years to keep burned areas within acceptable limits, to develop the resources of people, and important too to be able to increase effort during severe years using alternative techniques.

In general, these recommendations are based on the situation as we perceived it at the time of this study. We believe these will give cost-effective direction commensurate with values. However, any policy must be subjected to continuing review, especially as answers to some of the outstanding questions are obtained, needs of the people are better defined, and in light of changing conditions, costs, values and uses. It is important, too, to provide room for judgment by the managing agency to enable flexibility to meet particular circumstances.

12.2 Public Participation

At every meeting and in numerous private conversations the question of public participation was raised. The subject was a point of concern among virtually all people. They want to be involved in the decision-making process for actions affecting lands and the resources used by people from their communities. This desire for public participation is a global phenomenon and has changed conditions for agency management. Abraham Lincoln summed it up well when he stated "Public sentiment is everything. With it nothing can fail, without it, nothing can succeed." The U.S. Forest Service guideline in this respect is to "inform and involve."

We recognized high levels of frustration among the Northwest Territories residents with whom we visited. A commonly stated claim was that they had little chance to speak, visit or exchange views with policy-makers, and had no response when they did. A typical question raised at Fort Simpson was "why has the government not asked our elders for their advice and views". A typical comment from Fort Smith was a request to "ask us how to do things — you have always been able to impose your ways."

These comments indicate that more effective consultative mechanisms are needed. This is required on two general levels, formal and informal. The subject of informal information exchange is dealt with in Section 12.11.

Involvement should be encouraged in:

- a. setting objectives
- b. identifying critical areas and determining priorities
- c. developing attack strategies utilizing manpower and equipment within cost-effective limits
- d. determining appropriate fire actions for escape fires as related to values threatened (Section 12.4)
- e. fighting fires

Involvement must be provided on a basis which will provide opportunities genuinely given in good will and in good faith. We recognize that there have been problems in the past and that at-

tempts have been made by the Forest Service which have often not worked out. Granted it is difficult to arrange meetings given the comings and goings demanded by the land-based activities in communities, and the many Forest Service commitments. However, we believe that:

- a. the Forest Service must make a persistent and sustained effort to provide opportunities to get people involved in policy discussions and communication in operations, and
- b. community leaders, in turn, must realize that participation takes Forest Service time too, and must make efforts to make themselves available, being at meetings previously arranged or advising in good time if plans need to be changed.

The keys will be persistence, good faith, and taking every opportunity to bring this about. It is essential that there be a joint search for alternatives, to discuss and work out problems together, and to develop reasonable options within the inevitable budget limitations. The fire management task is not a simple one.

Recommendation 23:

A Forestry Advisory Board must be established for the Northwest Territories to provide a formal means to give responsible advice on setting of objectives, and determining priorities. Membership on this Board should include such representatives as the Forest Service, Hunters and Trappers Associations, Dene Nation, Metis Association, NWT Grade Stamping Association, Lodge and Resort Owners Associations, the GNWT Wildlife Service and others with particular interests in the land.

Recommendation 24:

Local forestry advisory groups must be established at the community level to advise on local priorities, and to develop mechanisms for consulting on values threatened by escape fires with respect to determining future actions. The membership on these Boards should include the Band Chief, Band Council representatives, Hunter and Trapper Association Executive, community council members, GNWT Fish and Wildlife officer, and others as appropriate to the locality.

These Boards should play an important role in providing responsible guidance to the Forest Service. The role we envisage is analogous to that of the Northwest Territories Wildlife Advisory Council. We expect that the roles played will become increasingly responsible as the governing body of the Northwest Territories evolves.

The Forest Service should routinely organize at least two meetings per year at both levels. One would be a pre-season information session. The other would be a post-season review of results and would incorporate planning aspects for the next season.

The discussions within these Boards should help to ensure that the concerns about the resource users are well aired and that the problems of the Forest Service are also made better understood.

The local advisory groups should be advisory to the District Forest Service office and to the Northwest Territories Board. The Northwest Territories Board would be advisory to the Director of the Northern Affairs Program and to the Deputy Minister of Natural Resources for the Northwest Territories.

12.3 Land Resource Management Objectives

Representations to the Panel clearly conveyed the concern that more of the perceived resource values be protected. Since the cost of protecting all areas is prohibitive, the technical capability to control all fires does not exist, and total fire exclusion is not desirable, it is es-

sent to have objectives to guide fire management activities. These objectives must be related to the overall land management objectives, but, as pointed out, there are virtually none. Although we have presented a proposed set of forest and wildfire management objectives in Chapter 11, we believe that they should be reviewed and improved based on articulated requirements of various natural resource management agencies and based on consultations with the people of the North.

Recommendation 25:

Staff of the Northern Affairs Program must take the initiative in developing a statement of land management objectives for the Northwest Territories. These objectives should deal with the land as an entity, and all products deriving from it. These include wildlife and fur, timber and wood supply, water and fisheries, recreation, as well as aspects related to general ecological concerns, and cultural views. These objectives must be developed with full participation of the people with interest in the land, and working through the advisory boards mentioned previously. The objectives should be developed to provide management for the people, commensurate with the ability of the agencies to manage the resources.

As land resource management objectives are described it will be possible to refine the existing fire management objectives to fit. At present we see a basic difference in philosophy between policy objectives of the Forest Service and the hunting and trapping public. We see the Forest Service stressing creation of an efficient fire control agency based on the latest technology to meet the needs of the present fire policy and budgetary restrictions. On the other hand, we see the hunting and trapping public stressing the need to change the policy to allow fire action on areas which they perceive to be important and to change Forest Service control procedures to enhance the chances for local people to be brought in to a greater extent in protection activities. We believe that the recommendations in this report will lead to a closer meeting of minds in this respect.

Recommendation 26:

The Forest Service should refine the fire management objectives offered in the Panel's report to respond to emerging Northwest Territories land resource management objectives, using the same consultative mechanisms outlined previously.

12.4 Defining Fire Management Zones

We found the definitions of the present Priority Zones for fire management to be reasonably precise as to which resources and geographic areas were included in each. However, the fire management policy objectives for each zone are so full of qualifying words ("manpower and equipment availability," "operational feasibility," "may be necessary to reduce," "limited funds") that fire management based on them is doomed to failure as a natural resource management function. These objectives that dictate fire control operations are so closely related to the financial management operations of the Department that they have little relation to the natural resource values that they purport to address. By strict adherence to the current policy objectives for fire control, the Department is in a position to have taken the correct action in every case, while failing to protect the natural resources of the area.

Given the limits of resources and funds, variations in land values, effects of fires and fire loads, some system of priorities remains necessary. At the same time, some room must be provided for human judgment, and extended protection areas to provide some buffering capability.

It is important that a system of zones and attack strategies protect human life and physical assets, along with protection of the resources that enable choice of lifestyles. At the same time policy must respect the integrity of ecological, socio-economic and fire management criteria. The following is recommended as a guideline within which to work, and which we believe will satisfy the major criteria. Details of the plan must be worked out by the Forest Service in consultation with those interested in the land.

Recommendation 27:

We recommend that the forested portion of the Northwest Territories be divided into two fire management zones — a Fire Attack Zone and an Observation Zone.

The basis of this policy in the Fire Attack Zone is a rapid, hard-hitting initial attack strategy. All new fires would receive strong and rapid initial attack with the objective of extinguishment within the first burning period, that is, before fire intensity begins to build on the second day. Fires that are not controlled within the first burning period will be subject to an escaped-fire analysis to determine followup action. Application of judgement by knowledgeable people is essential. Fires which may be controlled with minimal increments of cost, time and effort would receive continuing action. Fires that threaten human life and property will receive strong and rapid initial attack and sustained attack as required. Indirect attack by burning out of fuels should be assessed before attempting massive and costly direct attacks on approaching large fires.

For other fires that escape initial attack control during the first burning period decisions will be based on the escaped fire analysis by the Forest Service. If they can be controlled with minimal increments of cost they should receive continuing effort; otherwise they would normally be left in observation status and re-evaluated daily considering changes in weather and other conditions. Evaluation should be based on at least the following factors:

- threat to high value areas
- annual rate of burn in the region
- age class of likely burn areas as related to desirable age class distribution
- size of fire
- alignment relative to caribou migration
- spread potential considering season of the year, Fire Weather Index and Build up Index, long-range forecasts and fuel-type, possibilities for using natural barriers and indirect attack

Decisions could include: continued observation status, indirect attack, attack on part of the fire, or a new full-scale attack.

Maximum acceptable size of burn may be another refinement to consider. Literature on wildlife habitat suggests optimum production results from a mosaic of small burns. However, the fire history in this region is commonly one of large fires. Acceptable size would have to consider the intensity of the fire and its shape along with other factors. As previously stated, it may be desirable in future to consider low-cost indirect attack on observed fires as they approached or exceeded a guideline maximum size, and as opportunities for indirect attack on a cost-effective basis presented themselves. The Panel recognizes the great difficulties inherent in trying to put this practice into effect. It would likely only be possible where natural barriers could be used for indirect attack, or where weather changes made a hot-spotting initial direct attack possible. However, it is a concept which should be discussed.

With respect to isolated homes, lodges, mining camps and trappers cabins where full protection may not always be possible, the Forest Service should continue to provide a defensive action including such alternatives as direct attack where possible, indirect at-

tack by burning out, and evacuation. Protection through fuels management treatments by the owners must be stressed.

12.4.1 Full Protection by Sustained Attack

At the present time the only areas receiving sustained attack or full protection during severe fire seasons are those areas near settlements. Even in these areas the level of preparedness is sometimes inadequate and risks too high.

Although the Panel does not believe it necessary or desirable to extend full protection capability into all areas of the Fire Attack Zone, we do believe that those resources with the potential for stimulating economic development should receive full protection. As already discussed in Chapter 10, those areas capable of producing commercial-size timber fit this category.

Recommendation 28:

Full fire control capability must be extended to the potentially commercial timber stands in the Slave River Forest Management Unit and the Liard Forest Management Unit. This must include initial attack action in adjacent uplands.

12.4.2 Protection by Initial Attack

Delineating the areas containing resource values deserving initial attack protection will be an exacting task. It is important that it be done in consultation with the people who use the resources and the agencies responsible for managing the resources. Included would be isolated habitations; capital works, and certain identified areas that have particularly high value for trapping, hunting, or recreation.

Recommendation 29:

Initial attack capability must be extended to:

1. Capital works such as power and transmission facilities
2. Identified key trapping areas
3. Critical areas of caribou winter range
4. Lands with high capability for timber production, watershed value, or erosion risk.

The definition of resource areas for inclusion in the Fire Attack Zone should be made in the light of resource management objectives and the potential impact of fire and its role in the environment.

12.4.3 Defining and Redefining Protection Requirements

Obviously the Panel's recommendations to mount an initial attack capability in much of the currently designated Zone 3 and parts of Zone 4 can only be effected and phased in over a period of years. It must also involve the installation of an efficient detection network combining fixed lookouts, lightning detectors and aerial patrols, as well as availability of strategically placed suppression crews with appropriate logistical support.

To start the process and develop a schedule for its implementation it will be important to consult with the local Forest Advisory groups to determine their key areas of interest within, say, 160 km (100 miles) of their communities. A group review should be made of all areas since we anticipate that the level of protection can be reduced in some areas while increased in others.

Definition of areas may be made by assessing land management objectives and in light of fire effects and its role in the environment. We anticipate that the boundaries of this initial attack area will

shift periodically upon re-evaluation, and the area contained within it will contract and expand in response to ongoing assessment of fire activity.

In areas of particular concern for hunting and trapping we have suggested using the average annual rate burn based on a running 10-year average as a guideline for determining the need for fire action. If, for example, productivity of lichen in the caribou range begins to reach satisfactory levels in 50 years and falls off 150 years after a fire, then fire renewal on a 100-year rotation appears appropriate. This suggests an "acceptable burn" of about 1% per year at least in southern areas. This figure should be calculated on a regional basis considering wildlife movements and use patterns. It must be tempered with assessment of the size and alignment of existing burns, and an evaluation of human use in the area. The example given relates to caribou use only, and guidelines may be refined in consultation to develop a more optimum figure considering all wildlife production and the degree of use by hunters and trappers.

The success of this system depends on the development of effective consultative procedures and establishment of working relationships between the Forest Service and the various users and other agencies. The area of this zone must be reviewed at the end of each year, and may be made smaller or larger in response to changing conditions.

Discussions during the Panel review period indicate that most resource users will be able to identify the most valuable areas for trapping and hunting, and the Northwest Territories Fish and Wildlife Service is also presently working on maps which will help to identify these areas.

The system is also dependent on hard-hitting effective initial attack lead by experienced, well-trained foremen.

12.4.4 Observation Zone

This zone will include areas where relatively little use is being made of the land, where rates of burn have been acceptably low, and where fire effects may at the time be beneficial, or at least neutral. Areas such as the south-easterly portion of the caribou range and parts of the Mackenzie Mountain region, for example, would fall into this category, along with others to be defined.

Fires in these areas would be observed and assessed in light of local circumstances to determine what action, if any, to take. These decisions would be made in consultation where appropriate and possible. The normal decision would be to continue observing.

Fire action decisions will involve considerations of many factors relating to resource values, fire ecology, human considerations, fire behaviour, fire attack strategies and economics. The individuals involved will have to be well-trained, experienced, and knowledgeable of local conditions. The Alaska experience indicates how the decision process may be refined in time as greater knowledge and experience is gained. The Forty-mile interim fire management plan is recommended for review (Alaska 1979).

Observation of fires that have escaped initial attack and fires that are not attacked in the first instance is an essential component of this policy. It is important to keep posted on the fire activity so that action decisions may be made as required. It is also important to observe to be able to provide accurate information to governments and to the public on fire activity.

Basic to deciding the area to be included in the Fire Attack Zone is an assessment of areas burned in the past decade.

Recommendation 30:

The Forest Service would be required to calculate the cumulative areas burned on a running 10-year average, based on an evaluation at the end of each fire season. This may be done by satellite imagery analysis. These percentages should be avail-

able for review at the time of the post-fire season Advisory Board meetings.

12.4.5 Summary

This policy will provide a more cost effective approach to fire management than the current system. A greater percentage of the fires that occur would be actioned when small, reducing the probabilities of having to initiate fire control action on fires that have already become large. Experience has shown the latter to be the greatest drain on the suppression budget.

The recommended approach offers the opportunity for fire management to respond to natural resource management needs. It is flexible, allowing areas under protection to vary depending on changing resource values and recent fire experience. It offers an opportunity to develop a phased strengthening of the program in response to the needs of the people.

This approach does not represent full-scale fire management. It does represent an intermediate step between an indiscriminate policy of non-action and full control. It allows some fire management decision-making, in consideration of resource management objectives.

12.4.6 Specific Areas Identified for Fire Action Zone

Some areas were identified as needing protection now. These are described here. Additional areas of initial attack action will be determined as a result of the community consultations.

Recommendation 31:

A beginning must be made in 1980 to extend an initial attack capability to the following areas:

1. That area of approximately 24 000 km² (9 200 sq. mi.) of the Canadian Shield about 110 km easterly of the Taltson River and between the border with Alberta on the south and Great Slave Lake on the north.
2. That area of about 40 000 km² (15 400 sq. mi.) north and west of Yellowknife indicated in Figure 12.2.
12.2.
3. The central portion of that area known as the Horn Plateau.

12.4.7 Caribou Range East of Fort Smith

Within a 39 000 km² (15,000 sq. mi.) block of caribou range east of the Taltson River on the Canadian Shield about 14 000 km² (5,400 sq. mi.) or 36% of the gross area has been burned in the last 12 years. This is an average annual rate of 3% which is substantially higher than the "normal" figures of 1% or less as previously discussed. The size of individual burned areas is also of serious moment. A continuous block of more than 885 000 ha (2.2 million ac.) was burned on both sides of latitude 60 in 1979.

Contributing to the problem in this area is high lightning incidence (Johnson and Rowe, 1977), and the apparent intensity of the burns.

Since this area forms a part of the winter range for the Beverly caribou herd and is also extensively trapped by holders of registered trapline permits, an initial attack fire management plan should be extended to the area, at least until the average annual rate of burn falls within acceptable limits. This initial attack zone should extend approximately 110 km (70 mi.) easterly from the Taltson River, an

area of about 24 000 km² (9,200 sq. mi.). The area in question and its fire history are illustrated in Figure 12.1. The area includes important residual habitat areas between recently burned areas, plus some unburned areas to the east to allow relocation of trappers with some assurance of protection.

The Forest Service should consider reopening one or more of the remote bases such as Porter Lake or at Snowdrift as a means for effecting this initial attack strategy, or consider opening a new base in a location to optimize initial attack capability. Further studies suggested in Section 12.15 include a method by which this may be assessed. The remote base could also play a useful role in gathering weather information, serving as a communications centre and a detection base.

12.4.8 North of Yellowknife

The Forest Service has done an effective job of protecting the present Zone 2 area north of Yellowknife. However, a block of approximately 40 000 km² (15,400 sq. mi.) north and west of Yellowknife has experienced about 10 400 km² (4,000 sq. mi.) of burn in the last 13 years, or about 26% of the gross area, an average annual rate of 2%. This, too, exceeds the "normal" or desirable figures cited earlier. This area contains winter range for the Bathurst herd of barren ground caribou and is also extensively trapped. The area must receive additional protection at least until the average annual rate of burn falls within acceptable limits. The area and fire history are shown in Figure 12.2.

12.4.9 Horn Plateau

The Horn Plateau area comprises about 8 800 km² (3,400 sq. mi.) lying above the 305 m contour (1,000 ft.) elevation experienced some large fires in recent years. Although not as extensively burned as the previous two, it does show an average annual rate of 0.92 per cent based on the last 13 years. The Horn Plateau is of concern for woodland caribou, and is also extensively trapped for marten. Initial attack should be extended at least into the central part where the annual rate of burn has been 1.6%, and to the other portions to ensure that the annual rate of burn does not exceed the guideline figure, or until continuing studies provide a better guideline. Figure 12.3 illustrates this situation.

12.4.10 Budget

Fundamental to ensuring success of this policy is capability to mobilize the resources needed to handle the fire loads to meet the management objectives, rather than scaling down protection areas to meet prescribed dollar limits. This policy is essentially one of an initial attack approach with escaped fire analysis which will be more cost-effective than the present system.

This proposal does not envisage an open-ended budget. Rather it is based on a competent fire suppression resource base provided through pre-suppression funds. Initial attack on fires in the Fire Attack Zone will ensure control of most of them. Those that escape will be assessed through the escaped fire analysis process, and may be observed and attacked again when auspicious, as outlined. Where life and major property values are threatened sustained attack would be maintained, as at present.

We have noted that the fire suppression budget has been "overexpended" in eight of the last nine years. This frequency of overexpenditures suggests that insufficient funds are being made available for the capital or presuppression budgets to cover such elements of fire management as detection, equipment, supervisory staff, employment and deployment of suppression crews. We believe

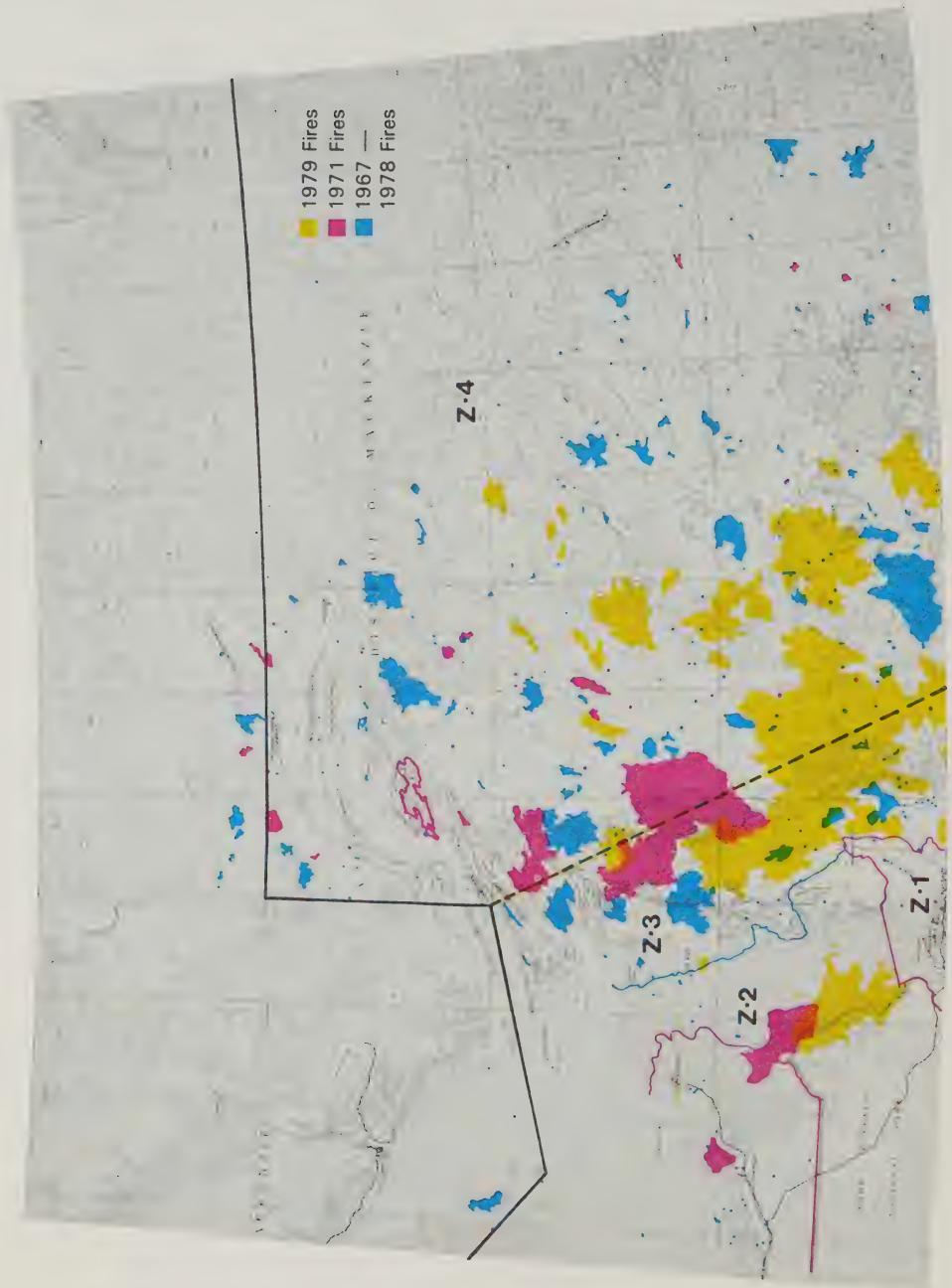


Figure 12.1: Caribou Range area east of Fort Smith burned in 12 years.



that greater cost-effectiveness will result if capital and presuppression budgets were augmented. Typical overruns in suppression budgets would then be reduced. At the present stage of development of the fire management service in the Northwest Territories we believe that every dollar spent on capital and presuppression would result in more than a dollar of saving in suppression budget overrun.

It should also be understood that fire suppression funds are commonly "overspent." Since fire loads cannot be predicted at budget time, a nominal sum is usually allocated with the understanding that additional funds will be provided to meet actual fire season needs.

It is essential that the Forest Service be able to take action in anticipation of fires occurring, such as moving suppression crews and aircraft to localities experiencing extreme fire hazard conditions. We understand that the accounting procedures of the Department do not allow such advance fire control strategies to be employed. If the accounting procedures for the presuppression budget cannot be made more flexible, then a general account should be set up to allow anticipatory action that is likely to save money in the long run by allowing speedier initial attacks on fires.

12.5 Back-up and Supplementary Capability

12.5.1 Introduction

No fire management agency can plan to meet the worst fire season entirely on its own. The cost to meet these occasional years is too great. Yet, it is at those times when it is most important to be able to expand protection levels to meet the increased threats to defined values. The answer, in general, is to plan a back-up capability to provide reserves on which to draw in order to meet situations of high fire starts of large fire occurrence. Circumstances at those times create a need for both manpower and equipment. Manpower is of particular concern — needed for supervision, for firefighters, and to provide such functions as service and supply.

In the Northwest Territories particularly, with small numbers in the Forest Service and a small population on which to draw, an aggressive program of recruitment and development of all possible resources becomes important.

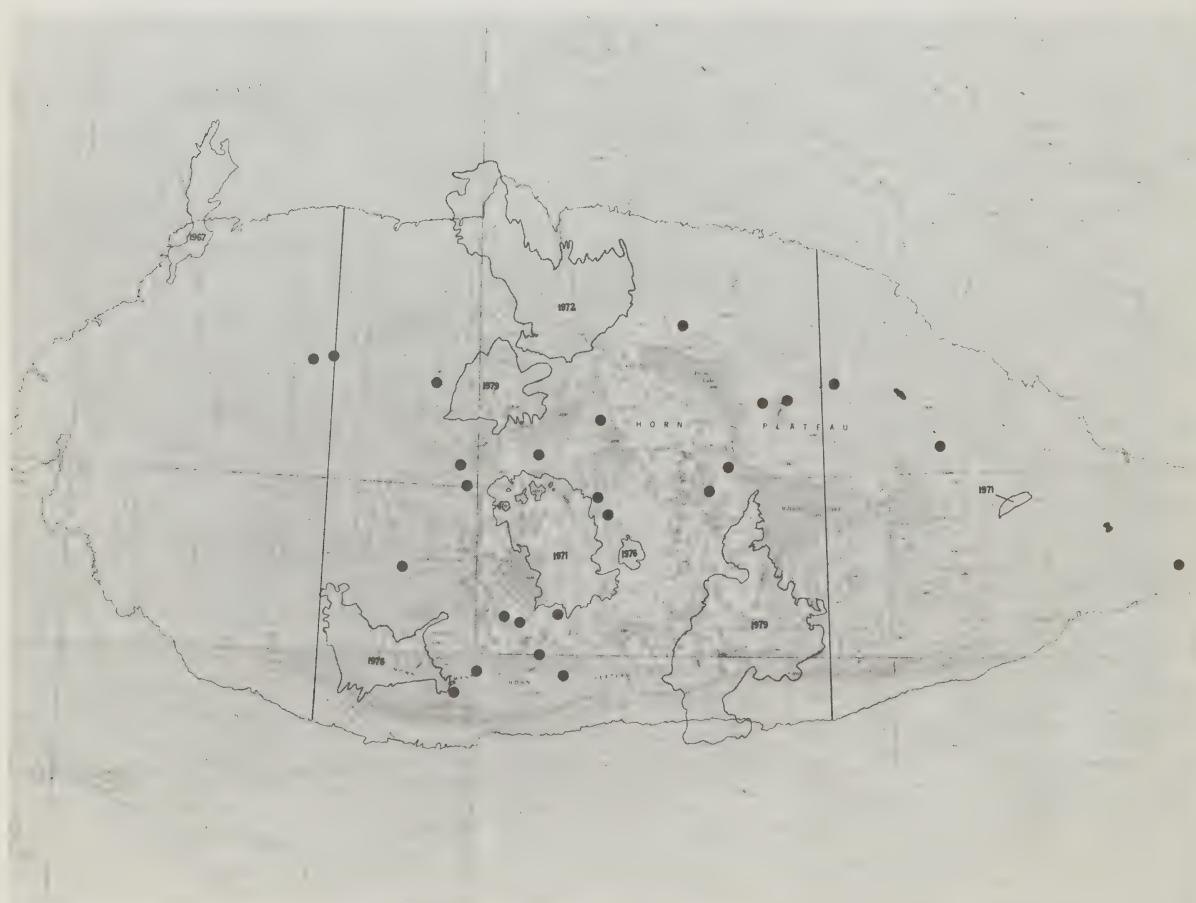


Figure 12.3: Horn Plateau area burned in 13 years.

Back-up resources are commonly recruited as the fire load increases. It would be preferable to be able to mobilize more in anticipation of problems rather than waiting for the problems to develop. Predictive capability can be improved by studying records of fire incidence and fire sizes related to such factors as lightning incidence patterns, rainfall patterns, weather patterns and FWI components. Reliable weather forecasts are also important.

Recommendation 32:

The Forest Service should work towards improving its predictive capability of fire loads through continuing studies.

12.5.2 Back-up Within Department of Indian and Northern Affairs

Greater opportunity should be taken to mobilize within the Northern Affairs Program in general. Some staff could fill fire line overhead positions by virtue of experience and training. Other staff could fill service and supply positions. A particular form of assistance needed is to help with financial services to expedite the bureaucratic procedures and complete the daily financial report.

Recommendation 33:

Fire control training and certification must be extended throughout the Northern Affairs staff of the Northwest Territories.

12.5.3 Cooperation with Territorial Agencies

A cooperative approach, particularly among land-related agencies, may be possible utilizing the experience among staff. Some would certainly be adaptable to fire line or other fire service positions. A particular assistance may be rendered through NWT Wildlife officers in the mobilization of manpower.

Recommendation 34:

The possibilities of an emergency assistance arrangement should be discussed with the GNWT Wildlife Service.

12.5.4 Communities in the Northwest Territories

The training and certification program should be vigorously extended into all communities, with appropriate local consultation. Community leaders should be involved in identifying potential supervisors to be singled out for special training. This subject is explored more fully in Section 12.7.

Community fire departments appear to be generally uninvolving in forest fire problems. Through the Government of the Northwest Territories the possibility of cooperative approaches for mobilization and initial attack on fires close to communities should be investigated.

Recommendation 35:

The Forest Service should develop mutual assistance agreements with community fire departments, in which forest fire-fighting equipment and training would be provided to the fire departments in exchange for provision of initial attack services in the immediate surroundings of the communities.

Where people have been trained within communities they should be used at every opportunity, rather than recruiting from outside the district.

12.5.5 Logging and Sawmilling Crews

Although in most cases people in this category would form part of the community manpower pool, logging and sawmilling workers should be singled out for particular attention in view of their interest in maintaining the forest resource base. Loggers particularly would have relevant skills. Again, identification of potential supervisors is especially important.

12.5.6 Property Owners

Efforts should be made to capitalize on the interest of such groups as lodge operators and those living in remote homes. These people could be involved in self-help training and familiarization. There appears to be a potential which has not yet been fully tapped. The costs involved would be minimal compared to the potential saving in the long distance patrols or firefighting attacks.

Recommendation 36:

Owners of isolated fishing lodges should be provided with firefighting equipment and training so that they may take initial attack action on nearby fires.

12.5.7 Within the Federal Government Generally

Discussion should be undertaken to enhance interchange of overhead personnel to individual fires or portions of fires with appropriate responsibility. The mutual assistance agreement with the Yukon should be thoroughly reviewed. Apparent differences in operational procedures must be resolved to enhance mutual use of air attack units. Assignment of crew units complete with overhead to individual fires with responsibility holds promise.

Recommendation 37:

The apparent differences in fire operations procedures between the Forest Services of the Northwest Territories and Yukon must be resolved in order to ensure free exchange of air attack units, manpower and equipment for mutual advantage.

Consultations should also be held within other Northern Affairs agencies to seek out appropriate manpower. Utilization of Canadian Forestry Service staff in service positions, and Atmospheric Environment Service staff providing forecasting services during high hazards could be particularly useful.

12.5.8 Regional Fire Fighting Cooperative

Possibilities of a regional cooperative involving the Northwest Territories, Yukon, Saskatchewan, Alberta and British Columbia should be explored as proposed by D.H. Owen, Director of Forest Protection for British Columbia. The possibilities include cooperative training and utilization of manpower, aircraft and equipment. This also envisages the assignment of crew units complete with qualified supervisors

who could assume responsible assignments.

Consideration could be given to group purchase of aircraft and equipment if mechanisms could be worked out for allocation of use and cost of maintenance.

12.5.9 Canadian Committee on Forest Fire Control

Although this is an advisory sub-committee of the National Research Council it has played an active role in fostering cooperative activities among the forest protection agencies in Canada. One of the cooperative activities stressed is that of manpower training and enhancement of manpower and equipment exchanges. Continuing support should be given through the CCFFC to try to enhance Canada-wide mobilization of manpower. Two major advantages would accrue. Help would be rendered to the receiving agency and experience given to the crews.

The Government of Canada has been negotiating an agreement with the Government of the United States through the Department of External Affairs to enable international exchange of manpower and equipment for forest fire control. This agreement has apparently not yet been completed but should be supported and kept in mind at times of extreme need. Cooperation with Alaska could be fruitful.

12.5.10 Fire Disaster Plan

It is essential that the Forest Service be prepared for unpredictable above-average fire years. A fire agency must have the capability and flexibility to expand its firefighting resources on short notice to meet heavy fire loads. Although exchange of manpower, aircraft and equipment can be prearranged with other forest protection agencies it is necessary to have a well trained and experienced fire supervisory hierarchy to direct and effectively absorb an influx of men and materials. All information must be detailed and kept up to date as a fire disaster plan.

Recommendation 38:

A fire disaster plan must be developed for the Northwest Territories in order to determine the precise limit of available manpower and other resources and the number of in-service supervisory overhead that are essential for the control of firefighting assistance brought in from outside agencies.

12.6 Enhancing Local Opportunities

12.6.1 Introduction

The Forest Service has a greater social role to play than it probably realizes, one that goes far beyond the putting out of fires. In the Northwest Territories there are limits to the numbers of people that the land itself can support. People also need a wage option to help to support themselves. The Forest Service as a major spender and with extensive and varied activities has a great opportunity to help both people and business, while receiving sorely needed fire management services in return. Fire management activities can play a social role in providing training and experience in skills, and managerial development. In view of the state of development in the Northwest Territories it is important that as much of these benefits as possible be directed to northern residents.

In our view the local people need to be brought increasingly into

the resource management activity scene. In the short run this can be done through firefighting activities, including overhead positions of responsibility. In the longer run it can be effected through training, experience and education both formal or technical and on the job.

The Panel was pleased to have heard from students of the Renewable Resources Technology Program. This program operated in Fort Smith is designed to provide training to educate technicians and field officers to serve in the resource fields of forestry, wildlife, fisheries, parks, water, and land use. The first generation of graduates is expected in the Spring of 1980. The establishment of this program is to be welcomed and is a commendable step in providing opportunities for native northerners. We note that there is pre-technology up-grading education available for those without a Grade 12 or equivalent education. We hope that this requirement and the course length and scheduling be kept as flexible as possible to enhance opportunities for interested individuals to attend.

Representations at the public meetings indicated strong local interest in and concern about local fire problems. It would be unfortunate not to recognize and take advantage of this strong interest. In general, a redirection would provide increasing gainful employment opportunities with the added benefit of training and development of their inherent capabilities. The point was also made that local people are adapted to the country and its conditions and their skills should be utilized. Elaborate base facilities in some cases could thus be avoided.

A more labour-intensive approach to fire control will be more difficult in many ways than through the application of modern technology alone. There may well be setbacks, but a sustained and earnest effort is needed along with active development of good faith within the communities. It will undoubtedly be a continuing job as well since competent supervisors will likely be in demand for other jobs, often at higher pay or longer terms than can be provided by the Forest Service.

It may also be argued that labour-intensive operations in the Northwest Territories may be more cost-effective. It would be interesting to apply the fire attack optimization model developed by Quinntilio and Anderson (1976) to assess the attack options which are available. We believe that the use of methods described in this report would be found effective.

The Panel was impressed during its travels with the variety of different ideas and philosophies among the various communities. It would appear important to attune specific actions to community preferences as much as possible to ensure harmonious working relationships. The advantages of contracting initial attack services locally within a community is worth considering, possibly through the Band Council or Hunters and Trappers Association. The contract could be for initial attack in designated areas of local interest within which the contractor would be left to work independently within agreed groundrules.

In one community it was suggested that they could consider purchase of their own aircraft if a long-term contract appeared possible. Another option, which we understand is being used in some communities, is to employ a local fire boss to be responsible within the community for such activities as recruitment of crews as needed, to be involved with or undertake training, to look after equipment, to do fire prevention activities and to possibly act as fire boss on initial attack. With training and guidance this individual could supervise community fuels management protection work, too. It would be important to identify suitable individuals through the community leaders and to discuss the options and preferences with them as well.

It was interesting to note that in many communities the concept of employment of crews only as needed was favoured over the employment of a full-time crew. The intent of this was to make it possible to draw from a pool of individuals to ensure that the work was spread around so that more than just a few were beneficiaries. This could be considered where a pool of qualified individuals was

available for rapid recruitment on short notice. An alternative could be to rotate individual crew members within a crew to effect an equity of employment opportunity. The basic concern would have to be to ensure a rapid initial attack, with short get-away time.

Recommendation 39:

The local Forestry Advisory groups in more isolated native communities where the Forest Service does not now have bases must be consulted to seek out potential fire control personnel and that these persons be employed and trained to do some or all of the following:

1. to maintain firefighting equipment caches
2. to act as initial attack crew bosses
3. to be responsible for providing a suppression crew on demand from local labour sources
4. to maintain a fire weather station and radio communication service with the fire management headquarters
5. to take initial attack with local resources and transportation when feasible.

Recommendation 40:

The educational requirements and other impediments in Public Service Commission job descriptions that inhibit employment and promotion of native people need review and replacement where possible with on-the-job training equivalents.

Wages for firefighters are low, contributing to local problems in recruitment. They should be increased to provide reasonable compensation for effort and clothing.

Recommendation 41:

The basic wage for extra uncertified firefighters should be based on the Northwest Territories minimum wage plus 20% in recognition of the rigours of the job and wear on clothing. A 50¢ per hour premium for certified firefighters is also recommended. Wage rates for other positions may be scaled proportionately.

12.7 Fire Suppression Methods

The Panel is concerned about the stress placed on long term fire retardants as an initial attack tool in the Northwest Territories. This material has become very expensive and several provincial agencies that used to employ it are now substituting short term retardant at about one tenth the cost or are abandoning chemical retardants all together. Certainly if initial attack crews can reach a fire within the useful life of short term retardant, long term retardant should not be used.

Statistics provided by the Canadian Committee on Forest Fire Control clearly indicate that most fire agencies have significantly reduced their use of long term retardant in recent years. (See Appendix). The Provinces of Alberta and British Columbia and the Northwest Territories were the exceptions, and in 1978 and 1979 led the rest of Canada in use of long term retardant.

Recommendation 42:

A thorough cost-benefit assessment of the effective use of long term retardant based on past fire records and current practices and studies should be made to determine whether or not its use could be eliminated or sharply reduced in favour of short term retardant, or simply water, delivered by less expensive aircraft. Cost savings might be directed toward use of local resources.

12.7.1 Contract Suppression Crews

During the last several years some suppression crews have been hired under seasonal contracts. Many difficulties have been encountered with charges and accusations presented by both the firm offering the crews and the Forest Service purchasing the service. There seemed to be a virtual breakdown of communication between the firm and the Forest Service. The Panel was unable to separate facts from the personal views that were expressed to us.

The employing of contracted fire suppression crews is appealing in concept, offering a flexibility in management not otherwise available. We believe it should be given a fair chance to demonstrate its effectiveness and cost-efficiency. Reasonably competitive financial terms should be negotiated. The Panel also believes that a trial contract for fire suppression in a specific area should be tried with a community.

Recommendation 43:

We urge two-year trials of contracted suppression crews with a commercial and a community source. The crews must be given specific assignments for which they would be accountable, and allowed to act as a integrated self-contained units.

12.7.2 Smoke Jumpers

At several public meetings the use of smoke jumpers as initial attack crews was criticised. Much of the criticism concerned the level of training and the ability of the smoke jumpers. The Panel finds that although this criticism may have had some justification in the past, it was not justified in 1979. Evidence presented to us indicates that the firm that held the contract in 1979 used well trained personnel and the crew was an effective initial attack force.

In light of apparent interest of native people to work on suppression crews, however, and the limitations on smoke jumpers opportunities caused by winds, slopes and timber conditions, we believe that the use of smoke jumpers should be reassessed.

Recommendation 44:

A cost/benefit analysis of the effectiveness of initial attack by smoke jumpers in comparison with helicopter delivered initial attack crews should be initiated in order to determine future policy.

If after objective review, smoke jumpers are found to be essential in some areas, the Forest Service should seriously consider recruiting and providing for training of northern residents through the contractor on a preferred basis.

12.7.3 Suppression Crew Morale

The concept of initial attack seems not to be clearly understood by all initial attack crew members. There was rather frequent dissatisfaction expressed by crew members in various locations over not being allowed to complete the firefighting job they had initiated. This dissatisfaction was particularly evident when initial attack crews were replaced on a fire and moved again to a holding camp to take up standby duty.

The procedure used by the Forest Service is perfectly sound in that the Service employs the more highly trained crews to control fires, then returning them to their base in readiness for possible new outbreaks. Crews "in training" are then used for mop-up and final extinguishment work. These crews of extra firefighters, employed as

required, provide essential back-up capability for the Service.

The issue is one for the Forest Service to encourage an understanding and pride among initial attack crews as to the importance of their specific function. The morale problem should then be overcome. Developing a stronger and extended initial attack strategy will also provide greater opportunities for crew action.

12.7.4 Initial Attack Incentives

The initial attack strategy involves getting hard-hitting crews on fires while still small, putting them out quickly and having the crews available for attack on other fires. In an area as vast as the forested Northwest Territories, distances from fire control bases to fire sites will often be greater than in the provinces. Since it will not always be possible to follow-up with sustained attack on fires that escape early attack, success of the initial attack is vital.

Recommendation 45:

The Department should consider the implementation of an incentive program to encourage success of initial attack operations. The incentive, for example, might be a bonus for all initial attacks that are successful in the first burning period.

12.7.5 Local Aircraft Firms

The unavailability of local aircraft for casual charter was a point of concern raised frequently by the Forest Service. The situation appears to have deteriorated in recent years. This is a serious matter that sharply increases the risks to successful fire suppression during periods of severe fire hazard.

It would seem appropriate to try to enhance the growth and viability of local aircraft charter firms. Many options are available, and others may materialize through discussions with local firms or representatives of the Northern Air Transport Association. It is important that there be good lines of communication established with all aircraft companies.

Recommendation 46:

The specifications and availability of local aircraft should be discussed before tenders are called for seasonal aircraft charter contracts with the Northern Air Transport Association to ensure that local operators are not inadvertently left unable to tender.

The Forest Service should also discuss the most appropriate length of charter contracts with local firms. It may be that if three year contracts were awarded, local firms would be able to consider purchase or lease of specific models preferred by the Forest Service. Certainly it would be important not to change aircraft or equipment requirements at frequent intervals if stability and growth are to be maintained by local firms.

12.7.6 Fire Management and Community Employment Projects

We expect that there are unexplored opportunities for cooperation between the Forest Service and agencies of the Government of the Northwest Territories that might provide extended employment periods and training while reducing social welfare dependency of some families. It may be possible to combine fire suppression crew employment with fuels management and hazard reduction projects

around communities road maintenance or campsite maintenance. We suggest that the Forest Service initiate discussions with Territorial agencies to examine the possibilities of mutually supportive programs that might provide longer periods of sustained employment.

12.8 Fire Planning Considerations

12.8.1 Prevention — Man-Caused Fires

Man-caused fires are still a problem as indicated by the 36 per cent of fires in this category in the Northwest Territories. At some of the meetings the Panel was told of human carelessness, especially along travel routes such as rivers and lakes. Others commented about how they had been spoken to by Forest Service staff in earlier days about carelessness with fire, messages which had left a lasting impression. Broadly-directed prevention programs are still important to create a general awareness. However, for effectiveness in specific locations to treat specific causes a more direct approach is necessary.

Recommendation 47:

The Forest Service must work more closely with local people in solving specific problems of man-caused fires, especially utilizing the help of local leaders. The objective should be to build understandings, and to achieve reductions in fire starts.

12.8.2 Prevention — Fuels Management

An additional approach to fire prevention is to reduce the flammability of fuels in critical areas. The results of work of this sort can reduce the chances of fires starting, reduce their rates of spread, and reduce their intensity which makes them easier to suppress when necessary.

12.8.3 Prevention — Fuels Management — Communities

The highest priority of forest protection has been directed at the welfare of communities of over 25 persons and associated property values at risk. In a fire emergency the amount and type of combustible fuel adjacent to the community is a critical factor. This was well exemplified in 1979 at the town of Pine Point where the final decision was to retreat from direct fire attack to the town limits to make a defence from prepared fire guards. The planned defence was to reduce the hazard by selective burning of the forest fuels between the town and any fire that was immediately threatening. The high cost of sustained attack on large fires that threaten communities can be reduced with an effective preorganized fuels management program. Fuels management plans need to be developed at all communities in the district during 1980 and 1981 and put into effect as soon as possible. The fuels surveys conducted earlier should be reviewed, and action plans developed.

Recommendation 48:

A survey should be made of all communities in the Northwest Territories with the object of identifying fire hazards due to forest fuel accumulation adjacent to town limits and the danger to the community from wildfire. The earlier studies should be reviewed.

Recommendation 49:

A planned program of fuels management must be prepared and implemented for all communities. The funding for the implementation of a subsequent hazard reduction program must be identified and the necessary work carried out as a high priority.

The Yukon manual for community protection through fuels management provides some excellent references. Some fuels management options include line clearing, thinning and pruning, and the disposal of surface fuels.

Recommendation 50:

It is important that work programs be developed cooperatively with the Government of the Northwest Territories to incorporate fuels management activities into fire suppression crew activities, as well as into manpower development and employment programs.

12.8.4 Prevention — Fuels Management — Cabins and Lodges

The Forest Service should advise those planning cabins and lodges how to best locate them to reduce the risk of loss by fire. The Service should also provide advice on hazard reduction possibilities around buildings.

Recommendation 51:

The Forest Service needs to encourage and assist owners of fishing lodges and cabins to plan and effect fuel hazard reduction programs around their properties.

12.8.5 Detection

An alert and effective detection system is essential to a forest protection agency. Rapid detection of fire is particularly important in the Northwest Territories where distances are great and initial attack forces often have to travel 80-320 km (50-200 mi.) to attack a reported smoke. Under such circumstances, early discovery is critical to fire control effectiveness.

The 1979 season highlighted weakness in the fire detection program. Several major fires developed through an inability to be detected when small. The fire that destroyed 30 percent of the timber inventory in the Slave River valley is one example. It is essential to be able to find fires while they are small in order to take effective control action. Without an effective detection system the initial attack strategy advocated here will fail.

The Northwest Territories fire staff deserves credit for the success of the electronic lightning detectors that are now in operation.

Recommendation 52:

A comprehensive overall plan for effective fire detection must be prepared and implemented in fire management areas. A detection survey by J. Niederleitner contains valuable background material and together with inservice studies in more recent years should be the basis for 1980 detection planning evaluation and decision making (Niederleitner 1975).

Recommendation 53:

A high priority is required in 1980 for the development of an

emergency detection plan to provide for the use of temporary lookout facilities, and funding for increased aircraft detection patrols during extreme fire seasons. The plan is of particular importance in the interim period before an improved detection network is implemented.

Recommendation 54:

It is urgent that an aircraft mount be prepared for the infrared scanner so that there will be a capability for infrared detection patrols if required in 1980. The mounting method used by the Alberta Forest Service is suggested.

Recommendation 55:

The Panel proposes that one twin-engined detection aircraft be chartered in 1980 for use throughout the Northwest Territories based on fire hazard and fire occurrence. One experienced aerial observer should be stationed with the aircraft.

Recommendation 56:

The use of directional lightning detectors must be expanded into protected areas of major lightning incidence, and the use of position analyzers for more definite fire location determination is needed.

12.8.6 Weather Stations

The treed area of the Northwest Territories represents one-eighth the area of Canada. Within this area there are only 10 weather stations, in contrast to 480 in Canada. Since weather factors are the major determinant of fire behaviour it is essential to have as reliable a service as possible, both for forecasting forest fire hazard conditions and for planning fire control strategies on major fires. The Panel learned of several instances where inadequate weather advice resulted in failures of fire control strategies and danger to the lives of firefighters.

Recommendation 57:

Additional weather stations must be established to fill in major voids in the existing system. Particular attention must be directed to the proposed Fire Attack Zone.

There are several relatively inexpensive approaches that should be explored, including:

1. establishing weather stations at new lookout towers
2. contracting for daily readings with individuals in communities, at lodges, at mines or camps, or at cabins with full-time summer residents
3. negotiation of cost-shared operation of weather stations during the fire season with the Atmospheric Environment Service where observations would also be of value to general forecasters and aircraft operators
4. establishing remote stations in particular locations where no other alternatives exist.

Fire weather reporting stations in the Northwest Territories are too few in number to provide adequate data input into local and regional fire weather forecasts and fire danger ratings. Some existing permanent weather stations do not provide weather information on weekends.

Recommendation 58:

An expanded fire weather station network is essential to progressive fire management. The planning, construction and cost-sharing of the new system needs to be coordinated with other Federal Agencies also interested in improved data.

Recommendation 59:

It is important that the Ministry of Transport be approached at a senior level to resolve the lack of weekend weather reports from their stations in the Northwest Territories.

12.8.7 Telecommunications

Reliable and rapid communication is essential for purposes of fire control. Telecommunication circuits were overloaded during the 1979 fire season. Radio circuits at fires were crowded causing delays in the delivery of supplies and equipment. Telephone and Telex circuits were not adequate to meet local and long distance demands. The telecommunication company has notified the Forest Service that there will be one dedicated line less in 1980. Fire radio service will be improved in 1981 by the addition of 2 channels to the existing Motorola five watt VHF portable radios. There is not a direct communication link available between Angus lookout in Wood Buffalo park and the Fort Smith District.

The lack of dedicated phone circuits at Fort Smith is a constraint to the use of a position analyzer on lightning detectors which could provide more accurate fire locations. The lack of sufficient circuits also hampers fire related communications at the Regional Centre.

The Ontario Forest Service is experimenting with a microwave audio visual satellite communication link using a receiving and transmitting disc. The project should be investigated for possible application in the North.

Most of the trappers in the Fort Smith have Citizen Band radios which could form an important communication link for reporting fires and for emergency contact with the Forest Service.

The communication network in the Fort Smith District is considered to be satisfactory for normal fire years. It does require greater flexibility and reinforcement in an extreme fire year or if the protection area is increased significantly. Telecommunication recommendations are applicable to the Northwest Territories as well as the Fort Smith District and are therefore made under Part III of the report.

Recommendation 60:

It is imperative that additional communication facilities be granted to the Regional Fire Centre at Fort Smith in order to assure rapid transmittal of essential fire related data.

12.8.8 Transportation for Initial Attack

The need for rapid initial attack on fires when they are still small is well recognized. In the Northwest Territories initial fire attack is primarily by small helicopters which normally carry three firefighters. A three man attack is too limited a force for success under conditions of extreme fire danger. The cost of two small helicopters attacking a fire is higher than the use of one larger helicopter. Additional support is provided if the helicopter is provided with a collapsable water bucket.

Recommendation 61:

The Panel proposes an increased use of helicopters capable of carrying five firefighters plus equipment for rapid initial attack on small fires.

12.8.9 Transportation of Equipment

Transportation of large amounts of firefighting equipment by helicop-

ter is very costly, especially in the Northwest Territories where fires can occur over large areas. During extreme fire years helicopters in the North are in short supply and priority use is for initial fire attack. The Alberta Forest Service, when supplying fires in remote areas parachutes equipment cargo from DC3 aircraft. The cost of removing equipment from remote fires can be higher than the original value of the material. In Alberta the use of disposable fire equipment such as paper sleeping bags, plastic tents, and cooking equipment has been cost-effective on fires that require aircraft transportation.

Recommendation 62:

In order to reduce transportation costs the application of air cargo drops from fixed-wing aircraft needs to be analyzed. The use of disposable fire equipment should be investigated on a cost effective basis and adopted if warranted.

12.8.10 Training and Safety

The fire management job is complex, and becoming more so. In making fire attack decisions fire bosses must consider many factors such as fire behaviour, attack strategy, logistics and supply, supervision skills, ecological aspects and economics. Efficiency of fire control operations can be enhanced through application of learned skills. We found existing training programs to be well intentioned but *ad hoc*, occasional efforts not yet consolidated into a comprehensive plan. This has created an unsatisfactory level of skills among Forest Service staff.

Recommendation 63:

A sustained comprehensive program of training and development must be prepared and acted upon, including attention to the following points:

- a. increased emphasis on the training and certification programs for firefighting within the Northern Affairs Program staff and within the communities
- b. employment of a native northerner to coordinate native training programs
- c. planned fire line experience is essential for effective training
- d. the development of local people who can eventually move into leadership, seasonal or full-time permanent positions must be encouraged
- e. local people should be brought in to assist with the training itself, taking the opportunity to utilize local ideas adapted to local conditions
- f. local leaders should be consulted about course curriculum to effect modification of training programs to meet local needs
- g. training must be directed to effective and safe operation of equipment including trouble-shooting skills. Individuals should be trained for versatility to ensure capability to handle many jobs and items of equipment
- h. safety and physical fitness aspects must be an integral part of all training and fire operations activities.

12.8.11 Safety

During times of heavy firefighting activity there develops a pressure for speed and production. These are best developed with training and experience. What must be avoided are shortcuts taken for expediency which may reduce margins for safety. Firefighting is a potentially hazardous activity and full attention must be given to safety. This includes continued assessment of fire behaviour and forecasts to anticipate changes. It also involves a variety of job-related precautions such as hard hats and chainsaw guards.

Recommendation 64:

A full safety consciousness must be installed into all staff through both instruction and supervision.

Aircraft pose particular concerns. Safety around aircraft must be stressed. It was suggested to the Panel on several occasions that there is strong pressure on fires to overload aircraft. We have not been able to substantiate these comments, but they should be investigated, and directives made to insure safe operating loads are maintained. Pilot fatigue can also be a problem — rest breaks must be provided as needed.

12.8.12 Large Fire Capability

A highly organized corps of firefighters and supervisors is essential to combat high priority fires that escape initial attack. In 1979 the Forest Service had the capability to manage one large fire requiring 100 men, in addition to initial attack forces. It is necessary that each district identify and have access to at least 70 trained men including supervisors available to combat escaped priority fires. In emergency years manpower and supervisory teams could be exchanged between districts to meet multiple large fire demands. It is also of critical importance that the Forest Service have the ability to absorb and control large self-contained firefighting units on loan from other fire agencies.

Recommendation 65:

The capability of each district to fight large escaped priority fires must be developed through 1980 and 1981 to identify a firefighter and supervision level of at least 70 persons.

Recommendation 66:

During fire emergencies it is necessary that the Forest Service organization develop a capability to absorb teams of firefighters and other resources from different fire agencies. It should be possible to utilize these resources by providing a liaison officer.

12.9 Aerial Ignition, Backfire and Burnout

Large fires burning out of control are difficult to manage in the Northwest Territories using conventional attack methods because of constraints in time, transportation, manpower and funds.

Barriers such as lakes, and rivers form natural "fuel breaks" which can often impede or stop the movement of wildfire. Man-made fireguards form artificial "fuel breaks" or barriers for the same purpose. Natural and artificial barriers are made more secure by igniting and burning out adjacent fuels between the break and the fire.

Ignition can best be effected by aerial ignition devices which are rapid, effective low cost and require minimum manpower. There are in operation several different ignition systems which need to be reviewed for effectiveness under northern conditions.

Aerial ignition techniques can assist in the redirection of fires threatening critical areas. They can be particularly helpful in burning out between natural barriers in advance of large fires.

Recommendation 67:

Aerial ignition techniques must be developed as an operational tool for improved control performance on large wildfires.

Recommendation 68:

One Forest Service fire behaviour specialist should receive instruction in aerial ignition techniques and be responsible for program establishment in each of the Forest Districts.

12.10 Environmental Constraints

The action of fighting fires can result in environmental disturbances,

sometime with consequences more lasting than the effects of the fire itself. This has not apparently been a serious problem in the Northwest Territories and is one of which the Forest Service is aware. However, recommendations are presented in response to comments received.

Recommendation 69:

Mechanical disturbances from fire suppression activities must be avoided in terrain on which serious environmental problems may later develop, such as on steep slopes with unstable soils, and in areas of permafrost where melting and slumping is a possibility.

Recommendation 70:

Fire camps should be kept clean, and must be cleaned up with garbage and litter destroyed or removed when they are closed.

Recommendation 71:

With the Department of Fisheries and Oceans, identify any critical spawning areas where uncontrolled fire could reduce fish productivity.

Recommendation 72:

Avoid retardant drops in or along water courses to prevent threat of poisoning fish.

Recommendation 73:

Consult with GNWT Wildlife Service and review Land Use Information Series maps to identify any areas in which fire or firefighting actions may threaten endangered species.

Recommendation 74:

Consult with those responsible for sites designated under the International Biological Program to determine fire or fire-action constraints needed, if any.

12.11 Staff Administration

Forest Service staff appeared interested in and dedicated to their work. Many were outstandingly committed, and the Forest Service is fortunate in having as many of these people as it has. One of the concerns frequently expressed related to the apparently high turnover in staff which affects the community perception of commitment to the job. It also affects continuity of work, experience levels, and reduces efficiency of operations by virtue of the disruptions which it creates. Loss of outstanding people is always of particular concern.

It is important to any organization to be able to attract and hold good people in all positions. Unfortunately, in the time available to the Panel, it was not possible to document staff turnover or the precise reasons for it. However, observations and submissions did suggest some factors which should be addressed. The recommendations following apply to both permanent and seasonal staff.

12.11.1 Orientation

One of the commonly expressed concerns about junior staff is that they were not fully aware of their role the resource management. This view was expressed particularly by native people. They perceived that many Forest Service staff had no apparent appreciation of the full implications of why they were hired, nor were they aware of how to get along in that country. Part of the problem lies in reaching agreement on basic land management objectives so they may be reviewed with new staff.

Recommendation 75:

Special programs must be arranged to bring the new staff member to as high a level of awareness about the nature of the job as soon as possible. The major points to consider include a detailed review of why they are there; the goals and objectives of the Northern Affairs Program; a review of local conditions and familiarization with the country; an introduction to the culture and traditions of northern residents; protocol for dealing with local people; and a planned program for gaining fire experience.

12.11.2 On-Job Factors

Satisfaction on-the-job and desire to stay with the Forest Service relate to such factors as the sense of mission, worth and contribution, opportunities for challenge and expression of initiative, and opportunities for personal development and advancement. Many of these factors seem absent in the Forest Service. The sense of mission can only be heightened through meeting defined fire management objectives. The present fire management staff is barely adequate to handle the present responsibilities and needs reinforcement, as recommended previously. Fire attack is commonly directed by the district staff of resource management officers and their assistants. This staff is responsible for other land-related tasks, and the variety of work thus provided enhances both resource management coordination and job satisfaction. However, when fires occur they command a priority, causing other work activities to suffer. During times of sustained fire action both fatigue and the strain imposed through other tasks adds to the stress.

Resource management officers have varying interests in and aptitudes for work in fire management. In-service assignments to fire control action should recognize these variables and staff must be given work assignments in fields in which they are most competent. Not all staff are necessarily capable of fire line and fire command work, but many do well in positions of support such as service and plans. The recommended program of training, testing and certification will help in this respect.

During the time available to us we were not in a position to assess total workload demands on the district staff. Part of the problem arises from the seasonality of work resulting in heavy loads at times. This suggests that some relief may be accorded through the increased use of seasonal staff.

Recommendation 76:

The Northern Affairs Program should arrange a review of the workload of its staff in light of increasing land-based activities. Action should be taken to ensure that staff is given demanding but reasonable workloads through employment of an optimum mix of permanent and seasonal staff.

While opportunities for rapid advancement within the organization are not that great, there appears to be potential for enhancing the nature of the job.

Recommendation 77:

Discussions should be initiated among staff to identify major concerns. In general, we suggest that responsibility and authority be further delegated to districts and to individuals should be given a wider mandate within which to exercise initiative and judgement.

Part of the problem undoubtedly lies in the fact that there is no clear mission or mandate defined to give management direction. Clear policy development and some stability in goals as described should help.

12.11.3 Family Considerations

Family life is a very important element in society, and perhaps more so in northern communities where access to a variety of amenities is limited. Factors such as enabling a reasonable time at home, ensured family vacations and reasonable ability to plan family activities are all important. The fire season places a particular strain on families as a result of uncertainties, short notices of departure and long periods away. Some opportunities for summertime family vacations should be provided. Families must be prepared to accept some disruption given the nature of the work and as a part of its mission in and contribution to the region. Most appear to have this commitment.

Recommendation 78:

Opportunities for allowing a reasonable level of family activities must be made a part of the planning process. Recommendations already made which could help to meet this recommendation include provision of adequate staffing and reliance on dependable trained seasonal and casual help, providing back-up support from other Northern Affairs Program staff or others.

12.12 Information and Education

The problem of communication is pervasive and is one of prime concern in any situation. In the Northwest Territories problems are compounded by distances, time availability, and differences in cultural views and languages. Some related aspects were discussed in Section 12.2 dealing with public participation. These following comments relate to less formal communications, but important ones nonetheless.

12.12.1 Community Relations

This is a very important facet of the fire management problem. Comments were frequently made during community visits that the people would like to see forestry staff more often, to visit and discuss problems with them. It is important to develop and maintain feelings of trust and mutual respect. This is a relationship which must be worked at on a continual basis. The difficulties imposed through staff turnover and lack of staff orientation were discussed earlier.

It was interesting, yet sad, to hear reference to well-manicured forestry grounds while fires were not being fought, and reference to demonstrations by smoke jumpers while fires were known to be burning unactioned. In both cases there was a perception of money being spent in the wrong place. The main object lesson is that good relations must be developed through sustained effort and action in addition to show

We recognize that Forest Service staff do make sincere efforts in this respect. The following recommendations are made to enhance the effectiveness.

Recommendation 79:

Forest Service staff must try to get better acquainted with the people for whom the service is being provided. Every effort must be made to visit, including overnight stays, to listen and discuss, to be receptive to problems raised, and to establish understanding.

Recommendation 80:

Enlist the assistance of other people who are already well-known and established within the community to ease the process of introduction and communication. Suitable individuals include the Chiefs, Band Councillors, native staff members, and other agency people such as GNWT Wildlife Service staff

or other travellers. It is particularly important that new staff visit to pay respects, identify themselves and learn of the local concerns and philosophies.

Recommendation 81:

The Forest Service should consider moving some staff positions to communities on a full-time basis in appropriate locations in order to get to know local conditions, people and areas better.

Recommendation 82:

The Forest Service must be responsible to advise communities and settlements directly should there be any threat from fire, or a perceived threat through heavy smoke drift. Local people must be involved in planning for defensive action and evacuation. Every attempt must also be made to advise cabin owners about threats to their facilities.

Trappers in a number of locations told of long travels made into new trapping areas or areas which had been allowed to lie fallow for several years in anticipation of a fruitful season. On several occasions trappers recounted running into extensive burns which they had not known existed. This not only resulted in a loss of trapping income but resulted in hardship as well since there was no food to be obtained from the land. Since the Forest Service maps fires during and after the season it should not be difficult to make this information available to hunters and trappers in communities.

Recommendation 83:

The Forest Service must make available sketch maps to each community, outlining the burns of the year in those locales hunted and trapped from those communities. This might well be done at the time of the fall post-fire review through the Forestry Advisory Board.

We understand that up-to-date displays of the current fire situation are maintained at District Headquarters. Hunters and Trappers expressed great interest in being able to keep posted on fire problems, and access to these displays and the daily fire reports would certainly be an important aspect.

The question of identity also has an important bearing on fostering community relations. Staff of the Forest Service are known over the entire region as "the forestry." The term still carries some respect based on long association with the Northerners. We believe it important to maintain an identity for that group to provide a public focus. "The forestry" should continue to be identified as the Forest Service in its public dealings.

12.12.2 Public Education

We see public education as a more formal undertaking carrying community relations a step further. It is as important for the various publics to understand the problems and constraints of the Forest Service as it is for the managing agency to understand the concerns of the people. Public education is one way of attempting to do this. It should be approached in a simple and straightforward manner so that it is not perceived to be "slick advertising." A great deal of public education will be achieved through the involvement and visiting programs already discussed.

One major need basic to defining land management policy is an understanding of the concept of the "natural role" of fire in the environment. Adding to the problem is the fact that many people will have seen productive areas burned over, not just those decadent unproductive sites.

Recommendation 84:

The Forest Service in cooperation with Northwest Territories Fish and Wildlife Service should develop a long-range plan to work with hunters and trappers to try to bring about an understanding of the role of fire in the environment, and ultimate acceptance of it within agreed limits. This must be a program involving discussions so that agency people can learn too from native observations.

Programs in schools were mentioned in connection with fire prevention. This suggests opportunities to introduce resource management ideas as related to fires. Involvement of local elders would add credibility to such endeavours.

12.13 Agreements with Adjacent Agencies

It is essential that agencies with bordering fire management responsibilities have policies on their adjacent lands which are compatible.

Two examples were demonstrated in 1979. East of Fort Smith the large caribou range fires represented a merging of fires burning in Northwest Territories, Alberta and Saskatchewan. A fire in Wood Buffalo Park, spreading under cover of heavy smoke, joined another in the Northwest Territories which went on to burn some 30 percent of the Slave River timber. These examples are given to show the fact that fire actions cannot be considered in isolation by any one agency.

12.13.1 General

Recommendation 85:

The Forest Service must initiate continuing discussions of fire management policies with all neighbouring agencies now. Negotiations must develop mutually acceptable fire-action guidelines.

12.13.2 Identified Opportunities for Cooperation

Agreements are now in place between the Northwest Territories and the bordering agencies of Saskatchewan, Alberta, British Columbia, Yukon and Wood Buffalo National Park. These agreements allow initial attack by either agency on any fires within ten miles of the border. These agreements, while important, should be carried further, on at least the following areas identified.

12.13.3 Fort McPherson — Northern Yukon

Residents of Fort McPherson expressed concern over fire policy as applied to both the Northwest Territories and the Yukon. The point was made that the people in that area had traditionally hunted and trapped that region before the administrative boundary was established and felt that they should also have the right to be involved in the discussion of Yukon policy even though they were not living in the Territory.

Recommendation 86:

Discussions should be initiated with the hunters and trappers of Fort McPherson involving representatives of the Forest Ser-

vices of both Yukon and Northwest Territories to identify initial attack possibilities by Fort McPherson residents and/or with Northwest Territories crews in both Northwest Territories and Yukon if established rates of burn or need for protection of critical areas warrant it.

With the Dempster Highway open to travel there is a risk of increased man-caused fires. Increased human activity may also require additional patrol for other resource management aspects. Although the Highway lies primarily in Yukon, it does pass into the Northwest Territories near Fort McPherson.

Recommendation 87:

The Forest Services of Northwest Territories and Yukon should provide approaches to detection, patrol and fire action along the north end of the Dempster Highway, the discussions to involve Fort McPherson residents, in order to work out a cooperative cost-effective approach to managing that area.

12.13.4 Fort Liard — Yukon — British Columbia

The timber along the Liard River has been identified as a resource of great potential value. Although a forest inventory is just in progress, it has been suggested that timber resources are adequate to support a moderate sized sawmill on a sustained basis. This could contribute substantially to economic and employment opportunities in that region. However, there is concern over levels of protection of this resource, particularly regarding the possibilities of large fires moving in from outside the protected area. Reference to protection of this resource within the Northwest Territories was made in an earlier recommendation.

Recommendation 88:

The Forest Service of the Northwest Territories and Yukon should negotiate a more formal agreement to assign responsibility for initial attack in southeastern Yukon to the Northwest Territories since those areas are closer and of greater immediate concern.

Recommendation 89:

The Forest Service should discuss with the British Columbia Forest Service the possibilities of extending the initial attack agreement further into British Columbia in areas of particular concern for protection of the Liard River timber.

The Canada Tungsten mine located in the Northwest Territories is reached by road through Yukon. Although there does not appear to be a high fire risk to this community, it is difficult to reach from the Northwest Territories side.

Recommendation 90:

The Forest Services of Northwest Territories and Yukon should develop a more formal agreement to assign responsibility for protection of the Canada Tungsten installations to the Yukon Forest Service since access and proximity are both related more to Yukon.

12.13.5 National Parks

Nahanni National Park requires particular mention, since fire control is effected by the Forest Service. Although considered in the present Priority Zone 2, most fires in the park have apparently been observed and allowed to burn. It was pointed out to the Panel that in-

creased tourist use will likely result in an increase in man-caused fires, and the presence of people may affect fire action decisions. Compounding the fire action problem is the complex chain of consultation required through officials in both organizations, apparently resulting in delays in making fire action decisions. The delays would pose no problems if the fires were to be observed and allowed to burn, but if attack were required these could result in serious delays. Discussions about the Nahanni area should include residents of Nahanni Butte.

Recommendation 91:

The Forest Service should initiate discussions with Parks Canada to determine their precise management objectives and define fire management zones. At the same time the decision-making responsibilities for fire action should be clearly defined, and authority for making initial attack decisions placed at a level that would permit decision without delay.

12.13.6 Manpower, Aircraft Charters and Supplies

In northern areas all resources are in limited supply. These are commonly identified as part of the pre-suppression readiness planning. Unexpected use of these resources by other agencies can create shortages and problems of re-supply. This was demonstrated in 1979 when the Alberta Forest Service used Fort Smith as a base from which to attack fires in northeastern Alberta.

Recommendation 92:

The fire management agencies should negotiate resource-use understandings as part of the border agreements in pre-season discussions, particularly with respect to supply and re-supply of critical materials.

12.14 Resource Inventories and Management Activities

12.14.1 Resource Inventories

The Panel was struck by the unavailability of resource data during the course of this review. With federal assistance the provinces had completed forest inventories by the mid-1960's, and many are resurveying resources for the second or third time. It was surprising to find, therefore, that there is not a forest inventory for the Northwest Territories, and more so to discover that an inventory of the major timber resource on the Liard River is only now underway. Granted, the forest values and demands for them were considered to be low. However, before a managing agency can effectively manage it must know what there is to be managed. As discussed earlier, there is no resource management plan and very little management activity other than the basic ones of inspection and control.

There have been special studies of some of the mature timber stands, but these have not been conducted in a coordinated way, so the data from each are not readily comparable. These surveys were intended to assess standing timber, and not to identify the better forest sites capable of producing commercial forest crops, but which at present may be unstocked or supporting young growth.

The Land Use Information Map Series contain a great deal of general but useful information, particularly about high-value areas for wildlife, fish, and recreation, and identify sites of historic interest. They also offer an approximation of forest areas with potential value.

In the absence of more formal inventories these maps could be used to advantage in determining land management objectives.

Recommendation 93:

The forest inventories now being funded must be expedited so that a forest management plan may be prepared to which a fire management plan could respond. The inventories must include an assessment of land capability for forest production in addition to measuring forest volumes.

12.14.2 Management Activities

The level of forest resource management is low. Characteristic of the development process is that attention was first directed towards resource protection and regulation of activities. Until land management objectives are more clearly defined and inventories completed it will be difficult to move strongly into management activities themselves. However, there are two fire-related activities which could be put into effect now.

12.14.3 Post-Fire Reclamation

Fires in 1971 and 1979 have destroyed standing timber resources in the Slave River Management Unit. These stands were located on sites capable of maintaining superior rates of growth and should be returned to production. A regeneration survey would identify understocked areas in the earlier burn. A selective program of planting should be planned now to be put into effect as soon as possible. The planting program should begin with collection of seed from superior trees in the better stands starting in the fall of 1980. Arrangements should be made for raising planting stock from these seeds either under contract or through a small agency-supervised nursery operation.

Recommendation 94:

A program of reforestation should be started as soon as possible, beginning with collection of seeds from stands of superior quality, and growing of appropriate planting stock.

Other suggestions were made to the Panel for post-fire treatments to enhance recovery of wildlife. These included planting of wild rice and grass in appropriate areas, and work to enhance muskrat habitat along the Slave River. These are interesting suggestions which could be pursued by the NWT Wildlife Service.

12.14.4 Applied Fire Management

Forest fire management has been defined by Barney (1975) as the integrating of fire-related biological, ecological, physical, and technological information into land management to meet desired objectives. Fire management is a logical progression in refinement of control activities. Use of prescribed fire and management of wildfires through selective attack are two approaches to applied fire management. Application of prescribed burns are also of great value in staff training, gaining fire behaviour experience, and developing knowledge of plant and animal response to fires.

The use of prescribed fire could be considered for specific objectives such as improvement of bison ranges, and improvement of habitat on selected sites for moose, waterfowl, muskrat and beaver when areas are no longer productive. Prescribed fire could also be considered for hazard reduction.

These burns are commonly done in spring, which ties in well to staff development and training needs. Experience with controlled spring fires, in contrast to intense uncontrolled summer fires, could

help to develop a better understanding of the role of fire. Involvement of local hunters and trappers should be encouraged in both planning and operations.

Recommendation 95:

The Forest Service should explore a limited program of prescribed burning for wildlife habitat improvement in cooperation with the GNWT Wildlife Service and members of Hunters and Trappers Associations.

The concept of managing natural fires to produce beneficial results deserves some consideration at this point. If resource values can be identified, and if an understanding of fire effects is in hand, the Forest Service could consider letting some fires burn in whole or in part to meet land management objectives. Given the current state of control and acceptance of fire this would have to be a much longer term refinement.

Recommendation 96:

The Forest Service should discuss the possibilities of the managed wildfire concept during general fire discussions in Communities and with Hunters and Trappers Associations. The option to apply this technique should be kept open to try specific actions when conditions appear appropriate.

12.15 Studies Needed

12.15.1 General

The Northwest Territories is a large region containing a tremendous diversity of conditions. There have been some excellent studies conducted within this region, most notable of which for our purposes were the Arctic Land Use Research Program series. However, there are still many large areas in which work has not been conducted, and still many questions in all areas for which there are not yet sufficient answers.

The basic purpose is to determine what is the optimum role of fire for management of the various plants and animals which have been identified as most important to people.

The large 1979 burns offer a particular opportunity to observe the effects of large burns on plants and animals. A number of the studies suggested here could take advantage of this situation.

As a general observation we encourage researchers to involve local people wherever possible in any studies. There are many people with a keen sense of observation who could well contribute insights based on their experiences. In addition to asking views, a number of active hunters and trappers could be enlisted in studies as field workers and as individuals to consult. Researchers should make themselves known to local people and should undertake to explain the purpose and nature of their studies.

To provide a pragmatic quick assessment we believe that it would be helpful if wildlife biologists could arrange to travel with full-time trappers in various regions of the Northwest Territories during the regular trapping season. This could provide very useful insights to guide further research activity. We expect that the biologists could make notes of the general effects of burns by observing the general locations of furbearers and big game, recording such information as habitat types, approximate years since fire went through, important vegetation, value of "stringers" or residuals, and noting also snow depth and conditions, and weather. These general observations related to quick productivity could help to provide some quick local guidelines for fire management, as well as give direction for further research studies.

A number of more formal studies should also be undertaken now to build a scientific base on which longer term decisions must be founded.

12.15.2 Vegetation

Many studies of vegetation and post-fire plant recovery have been made in connection with the ALUR program and Mackenzie Valley Pipeline studies. Additional studies are needed to indicate the rates of recovery of vegetation and habitat types suitable for various wildlife species in order to provide guidelines for developing assessment of habitats and "acceptable" rates of burn figures. Four regions in which surveys would be helpful are as follows:

1. Canadian Shield north of Great Slave Lake and east of the Cam-sell River-Marian River.
2. Interior Plains region bounded by the Camsell River-Marian River on the east, Mackenzie River on the south and west, and Great Bear Lake on the north.
3. Interior Plains regions generally north of Great Bear Lake.
4. Mackenzie Mountains region.

Several studies have been conducted in caribou range areas east of the Slave River. A question which does not appear to have been addressed specifically here relates to the impact of fire on thin soils and the exposure of rock in intense or repeated burns. The rates of vegetative recovery on these must be slower, and areas with this degree of sensitivity to fire may warrant special attention to maintain their productivity. Some of the 1971 and 1979 burns could yield information on the processes involved.

12.15.3 Wildlife

Barren ground caribou is the species of greatest interest. The immediate questions are to determine the effect of large burns on possible deflection of herd movements, the utilization of "stringers" and unburned residuals, use of emerging vegetation, and the effect of snow conditions on feeding. We note that the Department has already assisted in cooperative studies with the Canadian Wildlife Service and the Fish and Wildlife Service of the Government of the Northwest Territories, supported in part by an earlier recommendation from the Panel. Continued observation of caribou movements in relation to burns of various ages and conditions should continue until clear indications of fire effects are apparent.

Furbearers as a group represent the other most critical wildlife component. The immediate need is to quantify the effects of fire on furbearer populations through direct field observations of animals and their tracks. Studies in burns of various ages are needed to give indication of rates of recovery of furbearer species, and to assess the significance of unburned residuals of various sizes. Rates of repopulation as related to size of burn should also be studied.

Understanding of the fundamentals of population dynamics such as reproduction, mortality, and dispersal for major furbearers is either very limited or entirely lacking. Bunnell (1980) suggests that a critically important data base could be developed with relatively little expense if trappers could be enlisted in a cooperative study. This would consist of collecting a sample of jaws and ovaries from trappers for analysis to determine ages and reproduction rates.

Virtually no data exists for the Northwest Territories on the effects of fire on fish. Although apparently not a pressing issue, a well-planned research effort on a scale of sufficient depth and breadth to encompass the range and diversity of conditions could prove useful. The site of the large 1979 burn should offer some opportunities for study. In view of the reports of dead fish following forest fires, arrangements should be made to have fisheries biologists taken immediately to locations where this is observed.

12.15.4 Forest Fires

A high priority must be given to conducting operational-type studies designed to improve efficiency of the organization, as discussed earlier. In addition, several fire-related questions are evident among which the following need attention:

1. Potential use of satellite imagery was discussed in Section 10.6. Two programs should be undertaken to provide guidelines for re-defining fire attack zones. A simple monitoring of new burns would provide data for compiling rates of burn. Analysis of enhanced imagery and field checking would be of great value in selected areas to determine burn intensities and rates of vegetative recovery.
2. An optimization model to assess attack methods and to assist in attack base location has been developed for Alberta by Quin-tilio and Anderson(1976). Adaptation of this to conditions in the Northwest Territories by using local data would provide an excellent basis for discussion of strategy options, and serve as a guide for locations of such additional bases as might be needed.
3. The cost-effectiveness of various fire retardants is the subject of study within several Provinces. Specific trials in the Northwest Territories as a supplement to the ones conducted by the Canadian Forestry Service should be undertaken to test the particular retardant effects on typical northern fuels under influence of long daylight hours.
4. Continuing studies of climate, particularly airmass-fire relationships and of lightning prevalence as described by Rowe *et al.* (1975) would greater understanding of lightning occurrence and improve lightning fire predictive capability. Data collected through lightning detection equipment would assist this study.
5. Elements of Forest Fire Weather Index are very useful indicators of fire behaviour and provide guidelines for mobilizing in anticipation of difficulties when used in conjunction with weather forecasts. Further work in cooperation with the Canadian Forestry Service with respect to specific conditions in the Northwest Territories should yield additional useful guidelines.
6. Fuels management treatments for protection of communities and structures has been recommended. Guidelines for treatments are laid down in several manuals based on trials in other areas, observations and deductions. We recommend a trial of some of these treatments in a forest stand in a non-critical area which would be put to the test of an experimental fire to determine the actual effectiveness under northern conditions.
7. An understanding of fire history in various areas would yield insights to the role of fires and natural fire cycles, and may enhance predictive capability.

12.15.5 Social

The data base for determining the social impacts of fire is inadequate as reported in the Manecon study. Terms of reference for that report were developed cooperatively by the Panel in Fort Smith with the Government of the Northwest Territories and Executive of the Hunters and Trappers Association. We hope that the Manecon report has assisted in defining deficiencies and will contribute to developing the terms of reference for the further study planned by the Government of the Northwest Territories.

Fur harvest records from the Yukon have been compiled by trapline with data as early as 1950. Bunnell transferred the data base to computer records. He hopes in time to be able to measure effects of burns on trapping yields, and has given some indication of results in his report to the Panel. This approach looks interesting and would be worth testing in a selected area of the Northwest Territories, possibly in conjunction with the social study mentioned previously.

12.16 General Comments

12.16.1 Responsibility for Fire Management

One of the suggestions frequently made to the Panel was that responsibility for fire management be turned over to the Dene Nation in view of the particular interest in the land among its members. The Panel has considered this suggestion and believe that in light of the many and varied interests to be protected that the responsibility should remain with a government agency. However, there is no disputing the keen interest in the land expressed by members of the Dene Nation, the Metis Association and the Hunters and Trappers Association. As outlined previously, these groups must be brought increasingly into the planning process and into fire suppression operations. Also, as suggested previously, contracts with individual communities or bands could be considered with respect to action on defined areas.

Another suggestion frequently made to the Panel was the responsibility for fire management should be turned over to the Government of the Northwest Territories. This was usually based on the premise that in so doing fire control plans and actions would be brought closer to the people, and that the agency would be more responsive to local needs and concerns since the centre of decision would be moved from Ottawa to Yellowknife. Although this particular aspect is beyond our mandate, we believe that implementing our recommendations should largely alleviate the major problems, making the transfer suggestion less compelling. If the responsibility for fire management is transferred, the transfer should include all forestry aspects complete with full budgetary needs based on historical expenditure levels.

It has also been suggested that the Fire Control Centre be moved from Fort Smith to Yellowknife to be more immediately available for consultation during the fire season with the rest of the Northern Affairs Program group, the Northwest Territories Fish and Wildlife Service and others. The Panel sees no compelling reason to do this provided that the planning aspects described previously involve the other agencies and people to establish objectives and that consultative mechanisms are set up to enable strategy discussions during the fire season.

12.16.2 Loss Compensation

Any forest-based activity bears an element of risk of damage from natural causes such as winds, floods, or lightning fires. Many of these risks are not insurable since they are considered to be "Acts of God."

Although the Panel heard comments to the effect that insurance companies might consider insuring trapline values, none of the trappers we encountered in the North had insurance policies on their cabins, equipment or the productivity of their traplines.

The large fires of 1979 not only destroyed cabins and equipment, but seriously reduced or temporarily eliminated the furbearer productivity on at least 13 traplines and group trapping areas east of Fort Smith. This imposes real hardships on the individual trappers and their families.

In recognition of the severity of the situation, the Government of the Northwest Territories set up a special Disaster Compensation Fund which paid up to \$3 000 for replacement of capital such as cabins, traps, and equipment. At public meetings in Fort Smith the trappers complained that the compensation ceiling of \$3 000 was inadequate to cover investment losses and made no attempt to cover the present worth of future harvests lost.

As previously discussed, the Panel received an estimate of approximately \$12 000 for a trapper to reestablish on a new trapline.

We suggest that the Government of the Northwest Territories may wish to review the terms of its compensation program, particularly with respect to those trappers who are *bona fide* commercial trappers earning at least half their incomes from trapping, including those whose full-time traditional lifestyle has been impaired. We suggest that the emphasis should be addressed to assisting with re-establishment. This may be done through helping with reallocation of trapping areas, sharing capital replacement costs for establishing on new areas and sharing additional travel costs as a result of moving to more distant areas.

An alternative for the future would be a contributory trapper insurance scheme. The Government of the Northwest Territories may wish to explore the possibilities with representatives of the Hunters and Trappers Associations.

Many of the older trappers pointed out that the productivity of their traplines would never recover during their lifetimes. Some even believed that they would not have the stamina to build new cabins and clear new trails. We believe that in any new program the Government may select that these factors should be taken into account so that these individuals may continue productive lives in their chosen pursuits.

12.17 Summary — Priorities

Many recommendations have been made in this report. The general urgency of each is indicated, but some are more critical than others.

We have identified four areas into which additional protection must be extended now — the caribou range east of Fort Smith, north of Yellowknife, Horn Plateau, and the uplands along the Liard valley. For 1980 we urge the placement of 3 additional initial attack crew units with appropriate aircraft. Additional fixed-wing aircraft detection patrol must be provided. We see this as a critical initial response to the problems outlined.

Also for 1980 the following actions are needed.

1. Acceptance of the fire zone concept as a basis for wide-ranging discussions and action.
2. Starting the consultative processes.
3. Establishing 3 new full-time positions. A fire training position in the Regional Office is needed to give impetus to getting a comprehensive Territory-wide program underway. Two in the Fort Smith district would include a fire behaviour specialist and an additional assistant Resource Management Officer who would have many fire-related duties including dispatch of aircraft.
4. Starting the planning process for a fire disaster plan, along with operational planning for detection, prevention and training.
5. Starting some of the studies needed on fire effects, vegetative recovery rates and response especially of furbearers and caribou.

By 1981 plans should have progressed to the stage where additional specific actions may be made. It is difficult to identify all needs before the planning details begin. However, additional staff must include a full-time native northerner to coordinate training and development of local people. Effective use can be made of additional seasonal help to augment fire season capability.

The feelings of concern among residents of the northern communities were very strong, and with some justification. But their interest and support combined with a renewed mandate and direction to the Forest Service holds great promise for effective cooperative activity.

Chapter 13 Comparisons With Other Fire Agencies

13.1 Introduction

The Fire Review Panel asked for data from several representative fire agencies for the purpose of comparing policies and fire statistics with those of the Northwest Territories Forest Service. Information was received from Alberta, British Columbia, Manitoba, Saskatchewan, Quebec, Wood Buffalo National Park and the State of Alaska.

13.1.1 Protection Policy

The concepts of Protection Area, Partial Protection Area and Non-Protection area are not consistently interpreted by fire agencies. Can a region be considered part of a Protection Area if it does not receive adequate protection? What degree of fire control and/or fire management is required in a Partial Protection Area? These questions have no standard answers. The terminology for Protection Areas has little significance or credibility in recent years due to changing attitudes in fire management. In a Protection Area it may be decided to allow certain fires to burn for reasons of economy or to obtain benefits that have been recognized and approved by the agency. On the other hand, it may be necessary to take action on fires in Non-Protection Areas if life and property are threatened. These areas are summarized as given to us in Table 13.1. The philosophy and policy of an organization of managing fires is considered to be more important than protection area definition.

Table 13.1: Fire Agency Comparison
Protected Areas 1979
(Millions of Hectares)

Agencies	Area Protected	Partially Protected	Total Protected	Non Protected	Total Area
NWT *	16.63	5.78	22.41	114.21	136.62
Alberta	37.30	1.03	38.33	--	38.33
Alaska	77.07	--	77.07	--	77.07
B. Columbia	94.69	--	94.69	--	94.69
Manitoba	24.86	--	24.86	40.22	65.08
Saskatchewan	15.63	19.70	35.33	--	35.73
Quebec	50.83	29.70	80.53	72.27	152.80
Wood Buffalo National Park	4.48	--	4.48	--	4.48

* Partially Protected Area is Priority Zone 3.

British Columbia has a fire policy of early detection and rapid attack everywhere in the Province within the first burning period. If a fire escapes initial attack analysis and judgement are used to determine what the follow-up role will be. The northern regions of the Province are more limited in detection facilities and firefighting resources and subsequently receive a lower degree of protection than areas of higher resource value in the south.

Alberta has a Protection Area and a Partial Protection Area adjacent to the Northwest Territories. The policy for the Protection Area in the northeast corner as elsewhere in the Province is rapid initial attack followed by full suppressive action up to the limit of fire-fighting resources available.

The Partial Protection Area is within the Caribou and Cameron Hills in the northwest part of the Province. In this region, rapid and strong initial attack is practised. However, if fire is not controlled by 7:00 a.m. of the following day an escaped-fire analysis determines the strategy.

Saskatchewan has a Partial Protection Area adjacent to Caribou Range Sub-District. In the region action is taken only on fires posing an active threat to life or property of significant value. Manitoba has a Non-Protection Area in the North, but fire action is taken if communities are threatened.

Wood Buffalo National Park, immediately adjacent to the Fort Smith District, was considered a Protection Area in 1979. The agency has a strong fire detection system and takes aggressive initial attack on all fires up to the limit of its resources. Fires that escape control are analysed and a control judgement is made based on resource values, fire behaviour, cost and firefighting capabilities.

The State of Alaska has a protected area of 770 746 km² (297,587 sq. mi.). All fires receive aggressive and sustained initial attack. Life and property and unique values receive sustained follow-up attack. Escaped fires threatening other resources are analysed and discussions are made to determine strategy alternatives.

In summary the regions adjacent to the Northwest Territories receive a varying degree of protection from fire which is dependent on perceptions of resource values and the firefighting capability of the agency. We are not in a position to assess the populations and their degree of resource dependence in those areas.

Depending on the jurisdiction, fire adjacent to the Northwest Territories could receive no attack, initial attack with escaped fire analysis, and initial attack with sustained action. The values-at-risk are similar in the areas under consideration.

The new policy recommended for the Northwest Territories is rapid hard hitting initial attack on all fires in the attack zone with strategy decisions for escaped fires. Sustained attack will be made on fires threatening human life and major structures.

The statistics received from the other agencies have been compiled as requested. They are very difficult to interpret because of differences in methods of record keeping. Conclusions should be drawn from them only with great caution.

13.1.2 Protection Costs

Table 13.3 provides an insight into fire expenditures in relation to the area protected. The area of full protection for the Northwest Territories in 1979 was judged by the Panel to be Priority Zones 1 and 2 only. Priority Zone 3 was not included because fires in that zone did not receive initial attack.

There is considerable variation among agencies in the presuppression and suppression costs per hectare. If statistics for a 10 year period were used the results would be more significant and representative. However, there would still remain the question of whether or not all costs have been included in the totals — costs such as full-time ranger staff, government-owned aircraft, seasonal aircraft charters, and administrative costs.

Table 13.2 demonstrates the great variation among agencies in numbers of fires and areas burned. Each region indicated has its own peculiarities of fuels and climate, again making comparisons difficult. There is also variation from year to year which would change the relationships shown. Manitoba and Quebec both have Non-Protection Areas but apparently do not record fires within them.

Table 13.2: Fire Agency Comparison

Year 1979

Fire Occurrence and Area Burned by Protection Area

Totals	Protected Area		Partial		Protected		Non Protected	
	of Fires	Area ha Burned (acre)	of Fires	Area ha Burned (acre)	of Fires	Area ha Burned (acre)	of Fires	Area ha Burned (acre)
NWT *	192	163 005 (402,795)	47	956 351 (2,363,195)	141	869 734 (2,149,158)	380	1 989 090 (4,915,148)
Alberta	964	157 556 (389,330)	31	4 488 (11,089)	--	--	995	162 044 (400,419)
Alaska	332	157 428 (389,014)	--	--	--	--	332	157 428 (389,014)
B.C.	3849	25 744 (63,615)	--	--	--	--	3849	25 744 (63,615)
Man	645	91 519 (226,149)	--	--	--	--	645	91 519 (226,149)
Sask	292	4 734 (11,700)	118	216 110 (534,018)	--	--	410	220 844 (545,718)
Que	616	3 175 (7,845)	70	1 979 (4,890)	--	--	686	5 154 (12,735)
WBN Park	97	69 939 (172,822)	--	--	--	--	97	69 939 (172,822)
Yukon	52	412 (1,017)	--	--	13	6 936 (17,139)	65	7 348 (18,156)

* Partial Protected Area is Priority Zone 3.

Table 13.3: Fire Agency Comparison
Cost Per Hectare of Protection
1979

Agency	Area of Full Protection (Millions of ha)	Presuppression Costs (Millions of \$)	Presuppression Cost Per ha Protected (\$)	Suppression Costs (Millions of \$)	Suppression Cost Per ha Protected (\$)	Presuppression Suppress Costs (Millions of \$)	Total Cost Per ha Protected (\$)
NWT *	16.6	2.97	0.179	2.91	0.175	5.88	0.354
Alberta	37.3	7.61	0.204	10.49	0.281	18.10	0.485
Alaska	77.1	9.39	0.122	9.44	0.122	18.83	0.244
B. Columbia	94.7	12.70	0.134	21.30	0.225	34.00	0.359
Manitoba	24.9	2.65	0.106	2.16	0.087	4.81	0.193
Saskatchewan	15.6	0.64	0.041	2.20	0.141	2.84	0.182
Quebec	50.8	17.20	0.338	1.30	0.026	18.50	0.364
Wood Buffalo Nat. Park	4.5	0.20	0.044	1.28	0.284	1.48	0.328

* Protection Area Includes Zones 1 and 2.

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Appendix I A Ministerial Review of Fire Operations in the Vicinity of Fort Smith and of Fire Management Policy in the Northwest Territories

Purpose

To review the fire operations of the 1979 fire season in the vicinity of Fort Smith and make recommendations on fire management 45 p. policy.

Terms of Reference

General

1. The review panel will consist of three resource specialists having expertise in the fields of fire management, fish and game management, forest management, ecology or economics.
2. The panel will accept briefs, interview individuals or groups and utilize sub-committees as required.
3. The review will be conducted in two parts.

Part A

Part A will involve examining the forest fire situation in the Northwest Territories and assessing the efficiency of operations, adherence to fire management policy and dissemination of information in the Fort Smith District of the Northern Affairs Program.

Part B

Part B will be concerned with reviewing all aspects of fire management policy, criteria, objectives and fire action guidelines in the Northwest Territories for the purpose of recommending modification or continuation of the present policy.

Specific

Part A - Fire Management Operations

Using a standard type Board of Review or Fire Review procedure the Panel will:

1. examine the forest fire situation in the Northwest Territories in order to (a) assess the efficiency of fire management activities associated with the control of forest fires in the Fort Smith District and make recommendations for improvements, and (b) identify and make recommendations concerning any difficulties or shortcomings experienced by the Fort Smith District staff in adhering to the fire management policy in conjunction with existing priority zone criteria, objectives and action guidelines;
2. evaluate the accuracy of the information provided by the Northern Affairs Program staff to the Minister and the public.

Part B - Fire Management Policy

1. The panel will review the fire management policy, criteria, objectives and action guidelines and recommend either modification or continuation of current fire management policy in the Northwest Territories. Any recommendations are to be made either:
 - a) within the existing number of person years (57.5) and pre-suppression and suppression allotments; or,
 - b) in terms of proposed incremental increases in person years, presuppression and/or suppression budget allotments and associated benefits.

Each recommendation made under (a) or (b) is to include consideration of the following:

- i) the severity of damage to burned areas;
- ii) the loss of annual income and other benefits normally accruing to hunters, trappers, fishermen and Northwest Territories residents in general as a result of fire damage;
- iii) the recovery or regeneration rates of vegetation responsible primarily for providing food and habitat for game, furbearer, waterfowl and fish populations.

2. The panel will compare the Northwest Territories fire management policies, person years, budgets, fire costs per ha, resource values, compensation paid for fire damages and other pertinent items with those in selected Canadian and U.S. fire control agencies.

source values, compensation paid for fire damages and other pertinent items with those in selected Canadian and U.S. fire control agencies.

Formal Report

Two reports are required — one on fire management operations and one on fire management policy. The report on fire management operations is to be submitted with 1 copy not later than March 31, 1980. The report on fire management policy is to be submitted with 1 copy not later than March 31, 1980. For each report, an executive summary is to precede panel deliberations in which the rationale is developed. Supporting appendices are to be attached including lists of resource persons/groups interviewed, briefs submitted, reference materials, special sub-committee presentations and other pertinent information.

Appendix II Reports Sub-contracted or Requested by the NWT Forest Fire Review Panel

1. Bunnell, F. March 1980. Fire and furbearers. 60 pp.
2. Department of Environment, Canadian Forestry Service. January 1980. An assessment of fire intensity through analysis of satellite imagery. Prepared by P. Kourtz, Forest Management Institute, Ottawa.
3. DIAND Forest Resources. November 1979. White spruce saw-timber inventory Slave River F.M.U. and timber lost to 1979 fire. Report prepared by J.G. Gilmour, Staff Forester. 10 pp.
4. DIAND Forest Resources. December 1979. An analysis of the forest resources of the NWT. Prepared by J.G. Gilmour, Staff Forester. 68 pp.
5. Intera Environmental Consultants Limited. December 1979. Delinement of 1979 summer forest fires in the NWT, north of Lake Athabasca. 44 pp. + tables, map.
6. Intera Environmental Consultants Limited. January 1979. Delinement of 1979 summer forest fires in the northern and eastern caribou range. 4 pp. + tables, map.
7. Manecon Limited. February 1980. Assessment of the economic impact of forest fires on the renewable resources industry and communities in the Northwest Territories. Manecon Limited, Management and Economic Consultants, Edmonton, Alberta. 49 pp. + appendix.
8. Northcote, T. January 1980. A review of the effects of forest fire on aquatic ecosystems with particular reference to fish in north temperate-arctic regions. 24 pp.
9. Torrance Consulting Limited. January 1980. Brief to the Forest Fire Review Panel on the social impact of forest fires in the Northwest Territories. Torrance Consulting Limited, Camrose, Alberta. 25 pp. + appendix.

Appendix III Briefs, Submissions or Letters Received

1. Hon. George Braden, Minister of Economic Development and Tourism, Government of the NWT. 2 January 1980. 2 pp.
2. Buffalo Airways Limited, Box 168, Fort Smith, NWT. Letter commenting on Northern Air Transport Association, 8 January letter. Copy submitted by Don Harny, Operations Manager. 23 January 1980. 1 p.
3. Clayton Burke, RMO, Fort Smith, July 27, 1975. Practical field information on the 204 helicopter. Submitted to Fire Review Panel on behalf of the Fort Smith Hunters and Trappers Association. 13 December, 1979. 6 pp.
4. Canadair. Letter from David P.W. Wood, Director, CL-215 Marketing
5. Margaret A. Checkley, Helen Bailey, Margaret DesRoches, Sheila Kitar, Mary E. McQueen. Letter on behalf of the wives of several members of the regional fire centre, Fort Smith. Received 17 December 1979. 2 pp.
6. Community of Fort Liard. Brief to Fire Review Panel, Fort Liard, NWT. Presented 26 January 1980. 4 pp.
7. Dene Nation. Excerpts from the minutes of Fort Providence Dene National Assembly 28-30 August 1979 and others re: discussions relative to forest
8. Dene Nation. Excerpts from Berger Enquiry transcripts containing comments related to forest fires. Presented by Georges Erasmus, President. 22 January 1980. 2 pp.
9. Dene Nation. Draft resolution for forest fires dated 16 January 1980. Presented by Georges Erasmus, President. Received 22 January 1980.
10. East 3, Tours and Outfitting, P.O. Box 2356, Inuvik, NWT. Letter from G.A. Robertson received 7 January 1980. 1 p.
11. Peter Ferguson, 15 Mackenzie Avenue, Fort Smith, NWT. Final report Fort 172 p. + maps. Smith district - 1979 fire situation for the Hon. Minister of Indian Affairs and Northern Development. Received 25 January 1980.
12. Fort Smith Hunters and Trappers Association. Written submission to Northwest Territories Fire Review Panel. Submitted through Freeland, Robb, Royal, McCrum and Browne, Barristers and Solicitors, Edmonton. 21 March 1980. 48 pp.
13. B. Hartop. Brief on behalf of RMO's and ARMO's of the Fort Smith District. 29 February 1980. 4 pp.
14. Indian and Northern Affairs, P.O. Box 1500, Yellowknife, NWT. Copy of letter in response to 8 January Northern Air Transport Association letter. Written by R.W. Hornal, Director, NWT Region. 12 January 1980.
15. Kusawa Contracting Limited, 7 - 5688 Dalhousie Road, Vancouver, B.C. Letter in connection with smoke jumping. Submitted by David Thompson, President. 2 January 1980.
16. Kusawa Contracting. Smokejumper training report and outline of fire suppression training. Submitted by David Thompson. 11 March 1980. 11 pp.
17. Art Look, Fort Providence, NWT. Letter suggesting a fire suppression advisory committee. Submitted 28 January 1980. 1 p.
18. Catherine MacDonald, Box 342, Fort Smith, NWT. Statement on forest and wildlife resources, and views on fire and forest protection. Submitted 25 January 1980. 24 pp.
19. Michele MacDonald, Box 342, Fort Smith, NWT. (age 11) Comments on how she would feel if a forest fire burnt her trapline. 2 pp.
20. Trinity MacDonald, Box 342, Fort Smith, NWT. (age 11) Comments on how she would feel if a forest fire burnt her trapline. 2 pp.
21. Northern Air Transport Association. Letter regarding aircraft use on fires. Submitted by R.W.T. O'Connor, Vice-President, c/o Aero Arctic Limited, Yellowknife, NWT. 8 January 1980. 2 pp.

22. The Northwest Territories Association of Municipalities, P.O. Box 1529, Yellowknife, NWT. Letter outlining views on fire priority zones, communications and staffing. Submitted by Paul F. Nind, Executive-Director. 30 November 1979. 2 pp.
23. Northwest Territories Chamber of Mines, Box 2848, Yellowknife, NWT. Brief outlining the position of the mining industry. Submitted by T. Daniels, Manager. January 1980. 5 pp.
24. NWT Grade Stamping Agency, 6718 Strathmore Street, Burnaby, B.C. Brief reviewing the NWT lumbering industry and concerns about forest fire. Submitted by John R. Balckstock, Secretary-Manager. 21 December 1979. 3 pp. + 3 pp. att.
25. R.W.T. O'Connor. A brief forwarded to the NWT Fire Review Panel. Yellowknife, NWT. 12 January 1980. 14 pp.
26. Plummer's Lodges, 1110 Sanford Street, Winnipeg, Manitoba. Letter expressing concerns and suggestions relating to forest fires and tourism. Submitted by E.M. Plummer, President. 24 January 1980. 1 pp. + 1 pp. att.
27. Rae Band. Review of impact of fires, and containing recommendations. Presentation to Fire Review Panel by Rae Director of Economic Development. Presented 22 January 1980. 1 pp.
28. Renewable Resources Technology Training Program. Submission on behalf of students. Presentation to Fire Review Panel by Beatrice Lepine. Fort Smith. 24 January 1980. 3 pp.
29. Irene Sanderson, Fort Smith, NWT. Submission outlining forest fire experiences during the summer of 1979 at Schaeffers Lake. Submitted 12 December 1979. 2 pp.
30. Shirley Helicopters Limited, P.O. Box 1324, Inuvik, NWT. Letter and attachment regarding use of helicopters in fires. Submitted by Dale M. Fleming, Base Manager. 20 January 1980. 1 pp. + 2 pp. att.
31. W.C. Taylor, Regional Safety and Training Officer, Northern Affairs, Whitehorse, YT. Letter outlining views on forest fire suppression in NWT. Submitted 14 December 1979. 3 pp.
32. The Town of Pine Point. Submission to the NWT Forest Fire Review Panel. Presented by D. Hendry, Councillor. 23 January 1980. 2 pp.
33. Trans North Expediting Limited, P.O. Box 1077, Fort Smith, NWT. Letter and attachments regarding intention to salvage merchantable timber in the Grand Detour area. Submitted by Eddy Powder, President. 20 November 1979. 1 pp. + 3 pp. att.
34. Trans North Expediting Limited, P.O. Box 1077, Fort Smith, NWT. Points of discussion concerning fire review. Letter and submission 2 pp. Dated 10 April 1980, presented 11 April 1980.
35. Travel Industry Association of the Northwest Territories, Box 506, Yellowknife, NWT. Letter outlining views on the role of forest fires. Submitted by John F. Clarke, General Manager. 13 December 1979. 2 pp.

Appendix IV Communities Visited

Detah	22 January 1980
Fort Franklin	17 December 1979
Fort Good Hope	17 December 1979
	27 January 1980
Fort Liard	26 January 1980
Fort McPherson	16 December 1979
Fort Providence	21 January 1980
Fort Norman	18 December 1979
Fort Simpson	18 December 1979
Fort Smith	11-14 December 1979 24-25 January 1980
Hay River	25 January 1980
Inuvik	16 December 1979
Lac La Martre	21 January 1980
Norman Wells	17 December 1979
Pine Point	18 January 1980
Rae	22 January 1980
Snowdrift	23 January 1980
Wrigley	18 December 1979
Yellowknife	various dates - November 1979 - January 1980

Appendix V People Visited or Called

This list comprises those people who were sought out specifically by one or more Panel members for consultation. Discussions took place through visits, telephone calls, and correspondence.

Fort Smith

R. Bailey, Training and Standards Officer, Northern Affairs Program, DIAND.

J.R. Blackstock. Consultant to NWT Grade Stamping Association.

Clayton Burke. Secretary-Treasurer, TransNorth Firefighting Services Limited and member HTA.

R. Checkley, Head, Fire Control, Northern Affairs Program, DIAND.

L. Colosimo. Regional Superintendent, Renewable Resources, GNWT.

R. Des Roches. Co-ordinator, Fire Operations, Northern Affairs Program, DIAND.

P. Ferguson. Liaison Officer to Hon. J. Epp, Minister of Indian and Northern Affairs.

J. Gilmour. Staff Forester, Northern Affairs Program. DIAND.

D. Graham. District Manager, Northern Affairs Program. DIAND.

V. Hawley. Regional Biologist, NWT Wildlife Service, GNWT.

P. Johnson. District Protection Officer, Northern Affairs Program. DIAND.

J. MacEachern. Assistant Regional Director, GNWT.

E. Martin. Area Manager, NWT Wildlife Service, Department of Natural and Cultural Affairs, GNWT.

G. Mason, Fire Control Officer, Wood Buffalo National Park.

J. McQueen. Regional Manager, Northern Affairs Program. DIAND.

R. Mercredi. Area Manager, NWT Wildlife Service, Department of Natural and Cultural Affairs, GNWT.

D.P. Merserear. Regional Manager, GNWT.

E. Powder. President, TransNorth Firefighting Services Limited.

J. Schaeffer. President, Fort Smith Hunters and Trappers Association.

R. Schmidt. Fire Weather Technician, Northern Affairs Program. DIAND.

J. Tourangeau. Trapper and member HTA.

Yellowknife

J. Bendickson. Prelude Lake Lodge.

R.K. Bell. Supervisor of Wildlife Management, GNWT.

E.T. Boodle. Land Use Supervisor, Northern Affairs Program. DIAND.

J. Bourque. Area Manager, NWT Wildlife Service, GNWT.

G. Braden. Minister, Economic Development and Tourism, GNWT.

J.F. Clarke. General Manager, Travel Industry Association of the Northwest Territories.

T. Daniels. Manager, NWT Chamber of Mines.

P. Delaney. Dene National Staff.

R. Hornal. Director, NWT Region, Northern Affairs Program. DIAND.

T. Johnson. District Protection Officers, Northern Affairs Program. DIAND.

M. Johnston. Executive Assistant, Northern Affairs Program. DIAND.

R. Lamothe. Dene National Staff.

E. Land. Co-ordinator of Field Services, NWT Wildlife Services.

G. Lennie. President, NWT Metis Association.

R. Lynn. District Manager, Northern Affairs Program. DIAND.

N. MacLeod. Chief, Municipal Affairs Division, Department of Local Government, GNWT.

R. McKillop. Resource Management Officer, Northern Affairs Program, DIAND.

L. McTaggart. Metis Association of NWT.

H. Monaghan. Co-ordinator of Technical Services, NWT Wildlife Service, GNWT.

M. Morrison. Assistant Regional Director, Non-renewable Resources, Northern Affairs Program. DIAND.

R. Nerysoo. Minister of Natural Resources, GNWT.

R.W.T. O'Connor. Vice-President, Northern Air Transport Association.

J. Parker. Commissioner for the Northwest Territories.

A. Redshaw. Assistant Regional Director, Renewable Resources, Northern Affairs Program, DIAND.

J. Reid. Chief, Planning and Development Division, Department of Economic Development and Tourism, GNWT.

N. Simmond. Superintendent, NWT Wildlife Service.

B. Shead. Director of Economic Development and Tourism, GNWT.

G.K. Stangier. Director, Department of Social Services, GNWT.

B. Stephenson. Supervisor of Management Studies, NWT Wildlife Services, GNWT.

K. Thompson. Head, Travel Arctic, Department of Economic Development and Tourism, GNWT.

T. Warner. Member, Travel Industry Association of the Northwest Territories.

E. Watt. Regional Manager, Public Affairs. Northern Affairs Program, DIAND.

M. Wilson. Reporter - CBC Yellowknife.

Other Northwest Territories

D. Brackett. Fish and Wildlife Officer, GNWT, Norman Wells.

C. Cuddy, District Manager, Northern Affairs Program. DIAND. Inuvik.

B. Gauthier. District Manager, Northern Affairs Program. DIAND. Fort Simpson.

R. Lanoville. District Protection Officer, Northern Affairs Program. DIAND. Fort Simpson.

A. Look. Trapper, Fort Providence.

R. McMeekin. Lodge owner, Hay River.

R. Orbell. President, GNWT Grade Stamping Association.

Yukon

J. Doyle. Head, Fire Control, Northern Affairs Program, Whitehorse, DIAND.

E. Nyland. Regional Manager, Northern Affairs Program, Whitehorse, DIAND.

Ottawa-Hull

E. Cotterill. Assistant Deputy Minister, Northern Affairs Program, DIAND.

J. delestard. Forest Protection Advisor, Northern Affairs Program, DIAND.

J. Epp. Former Minister of Indian Affairs and Northern Development.

D. Gee. Chief, Land Management Division, Northern Affairs Program, DIAND.

P. Gimbarzhevsky. Forest Management Institute, Canadian Forestry Service, DOE.

A.H. Jones. Chief, Water Resource, Northern Affairs Program, DIAND.

P. Kourtz. Forest Management Institute, Canadian Forestry Service, DOE.

D. Lohnes. Chief, Natural Resources Division, National Parks Service, DOE.

J.E. Marshall. Director, Policy and Economics Branch, Environmental Management Service, DOE.

D. Merrill. Executive Director. Canadian Committee on Forest Fire Control.

W. Moore. Chief, Forest Resources Division, Northern Affairs Program, DIAND.

N. Novakovsky. Director, Canadian Wildlife Service, DOE.

M. Ruel. Director General, Northern Environment, Northern Affairs Program, DIAND.

J.S. Tener. Senior Policy Advisor, DOE.

B. Todd. Forest Management Institute, Canadian Forestry Service, DOE.

Alberta

J. Benson. Superintendent, Bow River Forest, Alberta Forest Service, Calgary.

D. Dube. Forest Fire Ecologist, Canadian Forestry Service, Edmonton.

R. Hall. Remote Sensing Technician, Canadian Forestry Service, Edmonton.

L. Huberdeau. Superintendent, Lac La Biche Forest, Lac La Biche.

H. Gray. Forest Protection Officer, Alberta Forest Service, Slave Lake.

A.D. Kiil. Program Manager, Canadian Forestry Service, Edmonton.

H.T. Lewis. Professor, Department of Anthropology, University of Alberta, Edmonton.

G.A. Longworth. Forest Superintendent (retired), Calgary.

J.K. Naysmith. Assistant Administrator, Environmental-Social. Northern Pipeline Agency, Calgary.

J. Neiderleitner. Head, Fire Planning, Alberta Forest Service, Edmonton.

R. Newstead. Forest Fire Research Officer, Canadian Forestry Service, Edmonton.

D. Quintilio. Fire Control Instructor, Forest Technology School, Hinton.

H.M. Ryhanen. Head, Forest Protection Branch, Alberta Forest Service, Edmonton.

G. Scotter. Wildlife Research, Canadian Wildlife Service, Edmonton.

B.F. Simpson. Head, Forest Technology School, Hinton.

S.J. Sinclair. President, Alberta Metis Association, Edmonton.

E.S. Teifer. Wildlife Research, Canadian Wildlife Service, Edmonton.

Other Canada

J.R. Blackstock. Consultant to NWT Grade Stamping Association.

A. Briggs. Forest Protection Officer, Manitoba Forest Service, Winnipeg.

K. Gorham. Forest Protection Officer, Department of Northern Saskatchewan, Prince Albert.

G. Ouellette. Manager, La Société de Conservation de L'Outaouais, Maniwaki, Quebec.

D.H. Owen. Forester i/c, Forest Protection Division, B.C. Forest Service, Victoria.

J.S. Rowe. Professor, Department of Plant Ecology, University of Saskatchewan, Saskatoon.

R. Sutton. i/c Planning and Development, B.C. Forest Service, Victoria.

U.S.A.

W. Adams. Protection Forester, State of Alaska, Anchorage, Alaska.

S. DeLeonardis. Chief, Planning and Program Coordinator, Bureau of Land Management, Anchorage, Alaska.

G.R. Fahnstock. Affiliate Professor, College of Forest Resources, University of Washington, Seattle.

E. Hurd. Chief, Branch of Fire Management, Anchorage District BLM, Anchorage, Alaska.

K. Johnson. Chief, Division of Operations, Anchorage District BLM, Anchorage, Alaska.

J. Kastelic. Chief, Fire Control Division, Bureau of Land Management, Anchorage, Alaska.

R. Ketchum. Chief Forester, State of Alaska, Anchorage, Alaska.

M. Lowden. Society of American Foresters, Portland, Oregon.

D.R. Miller. Assistant Professor, University of New Hampshire.

M. Miller. Natural Resource Specialist, Bureau of Land Management, Fort Wainwright, Alaska.

D. O'Connell. Fire Management Officer, Bureau of Land Management, Fairbanks, Alaska.

R. Settles. Assistant State Forester, i/c Fire Management, Anchorage, Alaska.

G.D. Timmons. Chief, Division of Fire Management, Bureau of Land Management, Fairbanks District, Fairbanks, Alaska.

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Appendix VI Proposed Agenda for Fort Smith Public Meeting December 1979

A Review of the 1979 Forest Fire Season in the Fort Smith District

Part One: Fire Management Background

1. Policy
 - a. Legal authority
 - b. Objectives
 - c. Priority Zone criteria
 - d. Priority Zone action guidelines
2. Budget
 - a. Presuppression
 - b. Suppression
3. Organization
 - a. NWT and Fort Smith
 - b. Districts
 - c. Personnel
4. Pre-organization
 - a. Manpower
 - b. Equipment
 - c. Aircraft
 - d. Telecommunication
5. Fire Causes and Prevention
6. Fire Detection
7. Lightning Detection
8. Training
9. Weather, Fire Danger
10. Suppression Techniques
 - a. Small fires
 - b. Large fires
11. Fire History
 - a. Statistics
 - b. Fire size and location
 - c. Rate of burn

Comments and questions from the public relating to Part One

Part Two: Review of 1979 Fire Season - Fort Smith District

1. Introduction
 - a. General review of NWT fire season
 - b. Fire occurrence
 - c. Area burned
 - d. Costs
2. Background to Fort Smith District season
 - a. Weather
 - b. Fuels
 - c. Pre-organization
3. Sequential development of danger and fire occurrence
4. Constraints to fire control and how resolved
 - a. Manpower (trained)
 - b. Overhead
 - c. Aircraft
 - d. Equipment
 - e. Budget
 - f. Communication
 - g. Visibility

Comments and questions from the public relating to Part Two

Part Three: Review of Representative Individual Fires - Fort Smith Area

Comments and questions from the public are invited following each fire review.

1. Fire CR2 - Caribou Range

2. Fire SM33 - Grand Detour
3. Fire SM38 - Tethul River
4. Fire HY41 - Pine Point

Part Four: Open Session to Hear Public Views

Northwest Territories

Forest Fire Statistics

Northwest Territories

Fires Fought By Priority Zone 1979

	Fought						Not Fought			Total Fires and Area (ha)			
	P.Z. 1	P.Z. 2	P.Z. 3	P.Z. 4	P.Z. 1	P.Z. 2	P.Z. 3	P.Z. 4	Number of Fires	Area (hectares)	Area (acres)		
Sub-District													
Fort Simpson	10 (10)	9 (18,385)	—	—	—	—	—	—	32 (121,097)	51	139,492	344,685	
Fort Liard	3 (2)	—	—	—	—	1	—	—	2 (16)	6	18	45	
Inuvik	9 (1,627)	4 (4,054)	—	—	1 (1)	—	1 (1)	—	—	8 (60,869)	23	66,552	164,450
Norman Wells	7 (2,412)	8 (12,530)	—	—	3 (1,624)	—	1 (2)	—	—	11 (36,583)	30	53,151	131,336
Yellowknife	18 (6)	22 (38)	—	—	1 (7,168)	4 (7)	2 (2)	15 (128,240)	29 (191,509)	91	326,970	807,943	
Caribou Range	1 (1)	—	—	—	—	—	—	—	—	46 (413,751)	47	413,752	1,022,381
Fort Smith	20 (171)	29 (96,600)	13 (57,516)	—	—	—	2 (1)	15 (770,610)	—	—	79	924,898	2,285,423
Hay River	19 (24,005)	19 (25)	2 (4)	—	—	—	3 (3,130)	2 (2)	8 (37,134)	53	64,300	158,885	
Total Fires	87	91	15	5	4	10	32	136	—	380			
Area Burned (ha)	28,234	131,632	57,520	8,793	7	3,136	898,852	860,959		1,989,133			
Area Burned (acres)	69,766	325,263	142,132	21,728	17	7,749	2,221,063	2,127,430		4,915,148			

NOTE: numbers in bracket = area in hectares

Canada - All Agencies 1970-1979
Number of Forest Fires and Area Burned by Agency

YEAR AGENCY	No.	1970		1971		1972		Acres
		ha	Acres	No.	ha	Acres	No.	
Newfoundland and Labrador	194	9 130	22,561	142	2 469	6,101	244	43 149
Nova Scotia	450	711	1,759	425	468	1,156	568	2 380
P.E.I.								5,881
New Brunswick	410	5 702	14,090	342	1 324	3,272	488	4 536
Quebec	1,048	31 160	77,000		>202 342	>500,000		
Ontario	1,231	22 711	56,121	1,782	14 649	36,199	1,573	31 865
Manitoba	320	37 831	93,483	490	8 903	22,000	450	16 511
Saskatchewan	345	424 920	1,050,000	340	86 581	213,872	442	207 439
Alberta	829	58 922	145,600	903	64 870	160,298	734	38 093
British Columbia	4,003	106 837	264,000	2,898			1 903	25 899
Yukon Territory	119	105	261	139	256 963	634,969	143	66 174
Northwest Territory	179	207 350	512,373	331	876 231	2,165,213	329	223 375
Parks Canada	137	77 360	193,150	145	157 730	394,325	66	416
								1,041

YEAR AGENCY	No.	1973		1974		1975		Acres
		ha	Acres	No.	ha	Acres	No.	
Newfoundland and Labrador	98	8 777	21,690	246	52 985	130,930	253	174 469
Nova Scotia	457	2 381	5,884	579	1 810	4,473	731	2 828
P.E.I.							49	112
								277
New Brunswick	300	359	888	464	1 039	2,569	470	2 916
Quebec	566	88 857	219,571	1,005	3 035	7,500	2,011	26 482
Ontario	1,101	36 143	89,310	1,108	520 870	1,287,096	3,146	15 855
Manitoba	615	24 442	60,398	491	>161 874	400,000	358	12 140
Saskatchewan	378	228 121	563,699	194	26 040	64,348	287	95 101
Alberta	476	10 686	26,406	595	>18 427	>45,536	691	5 867
British Columbia	2,863	33 184	82,000	2,558	21 712	53,652	2,713	24 889
Yukon Territory	111	1 455	3,597	92	1 550	3,831	166	37 298
Northwest Territory	490	852 794	2,107,297	184	37 229	91,997	338	520 427
Parks Canada	85	1 986	4,964	94	445	1,112	75	75
								1,871

YEAR AGENCY	No.	1976 ha	Acres	No.	1977 ha	Acres	No.	1978 ha	Acres
Newfoundland and Labrador	348	196 461	485,465	166	1 337	3,303	209	4 682	11,569
Nova Scotia	541	17 535	43,331	633	1 170	2,891	793	738.4	1,824
P.E.I.	33	115	286	70	530	1,309			
New Brunswick	413	4 539	11,218	520	1 204	2,975	841	2 682.7	6,629
Quebec	996	56 628	139,933	1,362	31 934	78,910	1,160	36 725	90,749
Ontario	2,049	416 317	1,028,740	939	7 523.1	18,590			
Manitoba	856	231 550	572,171	379					
Saskatchewan	396	130 128	321,552	348	92 662	228,973			
Alberta	556	15 738	38,889	652					
British Columbia	1,854	3 796	9,389	2,308	50 444	124,649			
Yukon Territory	126	277 075	684,666	102	7 395	18,273			
Northwest Territory	309	321 802	795,189	156	79 029	195,285			
Parks Canada	49	5 309	13,118	69	52	129			

YEAR AGENCY	No.	1979 ha	Acres	Average for Years Shown		
				No.	ha	Acres
Newfoundland and Labrador	191	39 076	96,559	209	53 254	131,503
Nova Scotia	682	754	1,865	586	1 497	7,605
P.E.I.				47	252	624
New Brunswick	409	1 405	3,474	466	2 571	6,353
Quebec	615	3 199	7,905	1,095	53 374	131,889
Ontario						
Manitoba	1,128	128 218	316,832	630	76 285	188,504
Saskatchewan	413	228 346	564,254	378	161 005	397,846
Alberta	990	162 059	400,456	720	41 879	109,035
British Columbia	3,849	29 307	72,418	2,584	39 224	96,924
Yukon Territory	65	7 347	18,156	118	70 817	174,992
Northwest Territory	380	1 989 133	4,915,148	301	574 920	1,420,558
Parks Canada	150	70 762	174,857	95	31 426	78,488

NOTE: Statistics shown were accumulated in December of each year and may vary slightly from final figures.

Canada - All Agencies 1970-1979
Annual Tanker Hours and Retardant/Water Dropped in Gallons

YEAR AGENCY	HRS.	1970			TOTAL	HRS.	1971			TOTAL
		R	W	TOTAL			R	W	TOTAL	
Newfoundland and Labrador	592					89			530,000	530,000
Nova Scotia							53.5			
P.E.I.									20,610	20,610
New Brunswick		125,000	----	125,000		242		60,400		60,400
Quebec	1,050	----	2,600,000	2,600,000						
Ontario		36,800	1,321,070	1,357,870		3,037		170,500	2,368,425	2,538,925
Manitoba						282		92,000	909,920	1,001,920
Saskatchewan	1,440	----	1,972,000	1,972,000		600			1,085,000	1,085,000
Alberta		557,522	----	557,522		18,295		1,262,475	713,350	1,974,825
British Columbia	3,677	4,500,000	----	4,500,000		3,056		1,993,000	470,000	2,420,000
Yukon Territory		10,000	2,000	12,000		321		35,872		35,877
							(+ 33 tons)			(+ 33 tons)
Northwest Territory		5,000	199,000	204,000		2,569		746,000	5,865,950	6,611,950
Parks Canada		23,150	823,200	846,350		7,260		407,000	6,350,000	6,757,000
TOTALS	-----	5,257,472	6,917,270	12,174,742	19,339		4,766,252	18,270,255		23,036,507

YEAR AGENCY	HRS.	1972			TOTAL	HRS.	1973			TOTAL
		R	W	TOTAL			R	W	TOTAL	
Newfoundland and Labrador	629	----	1,643,000	1,643,000		364			220,000	220,000
Nova Scotia	85	----	55,380	55,380		73			137,330	137,330
P.E.I.										
New Brunswick	340	54,000	26,000	80,000		68		14,800		14,800
Quebec										
Ontario	1,127.5				1,866,409	550.5	812,397	3,000		815,397
Manitoba	1,171	220,000	1,954,173	2,174,173		1,150		219,200	1,446,170	1,665,380
Saskatchewan	3,228	500,000	2,844,000	3,344,000		1,690		1,500,000	2,571,500	4,071,500
Alberta	1,956	1,025,120	556,915	1,251,205		552		152,268	74,720	226,988
British Columbia										
Yukon Territory	392.5	189,667	----	180,667		264		31,075	110,400	141,475
Northwest Territory	1,830	92,890	3,364,520	3,457,410		1,310.8		165,000	1,852,500	2,017,500
Parks Canada	44.25	13,000	163,000	176,000		199		133,800	39,000	172,800
TOTALS	10,767.3	20,856,677	10,606,988	12,692,665	6,022.4		3,028,450	6,454,620		9,483,160

YEAR AGENCY	HRS.	1974			HRS.	1975			TOTAL
		R	W	TOTAL		R	W		
Newfoundland and Labrador		----	708,000	708,000	1,129		2,000	2,640,000	2,642,000
Nova Scotia	200	----	237,970	237,970	291	----	326,210	326,210	
P.E.I.					----	----	----	----	
New Brunswick	310	96,400	23,500	119,900	336	150,954	12,514	163,468	
Quebec					3,460		2,000	10,000,000	10,002,000
Ontario	2,288	729,410	6,089,410	6,818,820	2,642.4	536,426	4,196,420	4,732,846	
Manitoba	1,229	275,200	1,199,950	1,475,150	696	1,028,800	248,290	1,277,090	
Saskatchewan	359	796,400	542,300	1,338,700		335,200	901,170	1,236,370	
Alberta	1,420.5	875,997	714,222	1,590,219	549.6	258,460	144,554	403,014	
British Columbia						1,570,000			1,570,000
Yukon Territory	125	67,400	22,400	89,800	179.75	74,400	102,070	176,470	
Northwest Territory	158.7	229,800	20,000	249,800	571.6	645,750	367,200	1,012,950	
Parks Canada	185	139,500	63,000	202,500	85	56,000	----	56,000	
TOTALS	6,275.4	3,210,107	9,620,752	12,830,850	9,940	4,659,990	18,938,428	23,598,418	

YEAR AGENCY	HRS.	1976			HRS.	1977			TOTAL
		R	W	TOTAL		R	W		
Newfoundland and Labrador	1,340	----	4,538,400	4,538,400	177	----	920,000	920,000	
Nova Scotia	218	----	240,730	240,730	147	----	206,110	206,110	
P.E.I.	----	----	----	----	----	----	----	----	
New Brunswick	2,366	144,960	20,280	165,240	360	117,870	420	118,290	
Quebec	1,222	----	7,494,800	7,494,800	1,594	----	9,500,000	9,500,000	
Ontario	1,246	925,880	13,862,188	14,788,065	1,624	324,230	4,648,415	4,972,645	
Manitoba	2,609	3,727,240	666,600	4,393,840	637	----	4,620,135	4,620,135	
Saskatchewan	499	41,200	1,094,300	1,142,500	2,416	108,800	1,192,120	1,300,920	
Alberta	1,192	404,100	1,023,100	1,427,200	820	553,256	439,125	992,381	
British Columbia	233	417,889	----	417,889	1,354	1,498,000	119,000	1,617,000	
Yukon Territory	150.5	56,012	87,340	143,352	2,077	127,864	2,013,594	2,141,458	
Northwest Territory	386.6	493,022	450,362	944,284	429	15,455	29,592	45,047	
Parks Canada	140.7	94,800	10,500	105,300	123	27,000	46,400	73,400	
TOTALS	11,603	6,313,003	29,488,597	35,801,600	11,758	2,772,475	23,734,911	26,507,386	

YEAR AGENCY	HRS.	1978			TOTAL	HRS.	1979		
		R	W	TOTAL			R	W	TOTAL
Newfoundland and Labrador	274	----	1,127,000	1,127,000	749	----	4,436,000	4,436,000	
Nova Scotia	189.5	----	221,670	221,670	223.6	----	47,748	47,748	
P.E.I.									
New Brunswick	936	340,000	144,250	484,250	275	59,120	23,280	82,400	
Quebec	1,149	----	7,050,000	7,050,000	675.65	----	3,788,000	3,788,000	
Ontario	484.5	22,020	1,280,740	1,302,760	1,446.6	20,940	4,231,080	4,252,020	
Manitoba	383	2,355	2,586,240	2,588,595	822	----	3,070,200	3,070,200	
Saskatchewan	785	102,000	1,129,620	1,232,620	981.7	201,024	871,800	1,072,824	
Alberta	1,249.5	670,297	800,440	1,470,337	3,095.3	1,319,324	2,801,348	4,120,672	
British Columbia	1,991	2,940,000	----	2,940,000	1,789	3,542,500	2,218,000	5,760,500	
Yukon Territory	199	56,408	108,680	165,088	36	39,997	74,372	114,369	
Northwest Territory	145	123,970	194,194	318,164	70.9	547,393	291,063	838,456	
Parks Canada	76	56,500	----	56,500	627.1	278,250	----	278,250	
TOTALS	7,861.5	4,313,550	14,642,834	18,956,384	10,801.8	6,008,548	21,852,891	27,861,439	

Alberta 1970-1979
Causes of Forest Fires in Percent*

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	14.8	13.9	17.6	14.0	26.8	17.6	27.0	17.8	20.5	
Settlement	11.8	11.8	20.0	5.7	12.6	15.0	9.0	5.2	4.2	
Woods Operations	2.4	1.9	2.1	2.7	2.8	2.3	2.0	0.8	1.4	
Railways	1.6	1.5	5.7	1.0	2.3	1.3	5.0	3.5	0.5	
Other Industries	3.8	3.3	8.2	5.5	2.3	6.3	8.0	5.1	3.6	
Misc. Known	3.3	4.6	7.1	6.9	8.5	9.5	14.0	12.7	5.7	
Incendiary	6.3	12.3	5.9	6.4	9.1	16.3	9.0	6.4	4.6	
Public Works	3.7	3.0	1.5	3.7	1.9	---	---	---	0.3	
Total Known Man-Caused	47.7	52.3	68.1	45.9	66.2	68.2	74.0	51.5	40.8	
Lightning	49.8	42.4	26.7	45.9	29.1	23.7	24.0	42.7	52.2	
Unknown	2.4	5.3	5.2	8.2	4.6	8.0	2.0	5.8	7.0	

*Based on number of fires.

British Columbia 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	7.6	7.3	9.9	11.8	11.3	9.1	17.7	24.0	8.2	7.1
Range Burning	4.8	3.6	3.1	2.7	1.3	1.6	6.3	6.0	1.2	0.9
Brush Burning	3.7	4.5	3.7	5.1	3.9	3.1	2.7	7.0	4.0	3.6
Railways	6.8	6.0	9.5	8.9	7.2	5.1	7.0	4.0	4.2	4.3
Industrial Operations	6.4	8.8	10.0	7.8	13.3	4.9	12.7	8.0	5.9	5.5
Incendiary	1.2	2.4	4.0	3.5	5.2	3.5	6.6	7.0	6.0	7.7
Misc. Known	11.3	10.4	14.6	16.1	13.1	9.3	14.1	14.0	8.9	9.2
Smokers	12.4	10.7	14.0	15.1	16.0	10.6	14.6	---	10.9	12.0
Total Known Man-Caused	54.2	53.7	68.8	71.0	71.3	47.2	81.7	70.0	50.4	49.2
Lightning	45.0	45.8	30.6	28.3	28.0	52.2	17.9	30.0	49.4	50.5
Unknown	0.8	0.5	0.6	0.7	0.7	0.6	0.4	---	0.2	0.3

Manitoba 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation								8.0		
Settlement								34.0		
Woods Operations								1.0		
Railways								3.0		
Other Industries								2.0		
Incendiary								16.0		
Misc. Known								8.0		
Total Known Man-Caused							66.0	72.0		
Lightning								23.0		
Unknown								5.0		

New Brunswick 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation			4.7	5.0	3.0	5.0	4.0	5.0	4.0	4.0
Settlement			10.2	7.0	9.0	4.0	6.0	8.0	26.0	29.0
Woods Operations			1.0	4.0	4.0	6.0	5.0	3.0	4.0	4.0
Railways			4.9	4.0	10.0	7.0	6.0	5.0	4.0	5.0
Other Industries			2.3	2.0	1.0	2.0	3.0	3.0	2.0	2.0
Misc. Known			59.0	60.0	51.0	45.0	49.0	48.0	5.0	23.0
Incendiary			9.2	9.0	3.0	4.0	4.0	4.0	26.0	1.0
Public Works			1.0	2.0	1.0	----	----	----	----	----
Total Known Man-Caused			92.2	93.0	82.0	73.0	77.0	76.0	71.0	68.0
Lightning			4.7	5.0	6.0	9.0	10.0	7.0	4.0	8.0
Unknown			2.9	2.0	12.0	18.0	13.0	17.0	25.0	24.0

Newfoundland & Labrador 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	6.3	4.5	4.1	13.8	14.0	17.0	10.0	18.0	8.5	
Settlement	4.2	9.8	19.4	11.0	5.0	11.0	10.0	9.0	11.0	
Woods Operations	8.5	5.7	4.1	2.8	6.0	4.0	3.0	5.0	2.0	
Railways	19.0	9.8	16.3	11.0	16.0	14.0	6.0	2.0	2.0	
Fishermen	10.6	3.7	3.1	---	---	---	---	---	---	
Garbage Disposal	---	---	---	---	---	8.0	---	7.0	6.0	
Incendiary	1.4	---	---	4.5	8.0	---	---	---	3.0	
Misc. Known	20.4	5.7	1.0	5.7	19.0	2.0	25.0	22.0	15.0	
Total Known Man-Caused	70.3	39.2	48.0	48.8	68.0	56.0	54.0	63.0	47.0	
Lightning	2.1	33.6	21.4	29.3	8.0	12.0	1.0	6.0	8.0	
Unknown	27.5	27.1	30.6	21.9	24.0	32.0	45.0	31.0	43.0	

NOTE: Campers, Berry Pickers, Travellers and Anglers were combined as "Recreation".

Northwest Territories 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	15.6	27.2	21.0	17.1	26.1	24.3	15.0	37.0	31.4	14.0
Settlement	---	1.5	0.9	1.6	1.6	0.3	1.0	6.0	10.9	2.9
Industrial Operations	2.8	1.8	1.2	0.8	2.7	0.9	2.6	8.0	8.3	3.7
Incendiary	0.6	0.6	0.3	0.8	---	---	0.6	1	---	---
Misc. Known	2.2	0.3	0.9	1.6	1.1	1.8	1.3	5	2.6	2.6
Smokers	1.7	0.3	0.6	0.6	---	---	---	---	---	---
Total Known Man-Caused	22.9	31.7	24.9	22.5	31.5	27.3	20.5	57.0	53.2	23.2
Lightning	75.4	64.4	68.7	76.3	63.6	64.7	71.5	40.0	43.6	76.8
Unknown	1.7	3.9	6.4	1.0	4.9	8.0	8.0	3.0	3.2	---

Nova Scotia 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	1.32	2.0	2.0	3.0	2.43	5.06	4.0	3.0	6.0	8.0
Settlement	5.10	2.0	2.0	1.0	2.95	2.47	4.0	22.0	12.0	17.0
Burning Brush	12.65	6.0	11.0	13.0	13.82	9.99	18.0	---	---	---
Railways	11.32	10.0	7.0	7.0	9.84	10.67	8.0	7.0	5.0	4.0
Other Industries	5.09	7.0	3.0	5.0	2.77	5.33	1.0	2.0	5.0	4.0
Incendiary	12.45	19.0	20.0	17.0	20.20	10.53	13.0	14.0	13.0	22.0
Misc. Known	10.57	12.0	19.0	11.0	10.36	12.72	8.0	33.0	31.0	18.0
Smoking	19.62	15.0	13.0	22.0	14.50	14.63	27.0	---	10.0	11.0
Fishermen	4.72	2.0	3.0	4.0	2.24	1.37	---	---	---	---
Total Known Man-Caused	82.84	75.0	80.0	83.0	79.11	72.77	83.0	81.0	82.0	84.0
Lightning	---	---	---	---	---	0.55	1.0	1.0	1.0	1.0
Unknown	17.55	25.0	20.0	17.0	20.89	26.68	16.0	19.0	17.0	15.0

Ontario 1970-1979
Causes of Forest Fire in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	30.0	39.0	22.0	31.0	14.7	30.6	20.4	26.0	38.3	N.R.
Settlement	11.0	11.0	12.4	15.0	13.5	8.9	6.5	14.0	9.7	N.R.
Woods Operations	---	1.0	1.0	1.0	0.8	1.2	0.6	1.0	1.9	N.R.
Railways	10.0	9.0	10.9	14.0	9.7	9.2	8.9	12.0	15.8	N.R.
Other Industries	1.0	3.0	2.2	3.0	2.1	1.7	0.6	1.0	2.3	N.R.
Incendiary	2.0	2.0	1.8	2.0	0.8	1.4	1.2	3.0	3.7	N.R.
Misc. Known	11.0	15.0	14.7	15.0	10.9	11.2	6.5	15.0	9.0	N.R.
Total Known Man-Caused	65.0	80.0	65.0	81.0	62.5	64.2	45.0	72.0	8.7	N.R.
Lightning	33.0	18.0	33.1	16.0	33.6	33.2	51.7	26.0	17.6	N.R.
Unknown	2.0	2.0	1.9	3.0	3.9	2.6	3.3	2.0	1.7	N.R.

Parks Canada 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation			20					39		
Settlement				Mt. Parks				7		
Woods Operations				Recreation & children = 45%				---		
Railways			10		Railroads = 25%		6.0	12		
Other Industries					Lightning = 23%		---	4		
Incendiary						14.0		---		
Misc. Known				All Other Parks		---		---		
Total Known Man-Caused				80% Lightning		51.0	62.0			
Lightning	66	50		Approx.		49.0	33.0			
Unknown						49.0	33.0			
						---		5		

Quebec 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation				30.0	7.0	13.0	31.4	28.0	34.1	32.8
Settlement				17.0	---	---	15.6	15.0	13.6	17.4
Woods Operations				11.0	---	---	8.5	7.0	7.8	13.7
Railways				5.0	1.0	10.0	4.6	6.0	3.7	5.0
Other Industries				18.0	16.0	27.0	7.8	10.0	20.9	11.1
Incendiary				2.0	1.0	6.0	8.1	4.0	4.3	4.7
Misc. Known				1.0	1.0	2.0	2.3	1.0	1.5	1.6
Total Known Man-Caused				84.0	26.0	58.0	78.2	71.0	85.9	86.3
Lightning				16.0	74.0	42.0	21.7	29.0	14.1	13.7
Unknown				---	---	---	---	---	---	---

Saskatchewan 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	26.2	27.1	15.1	20.0	16.0	14.0	14.0	25.0	14.8	
Settlement	17.9	7.0	9.5	8.0	5.0	24.0	25.0	11.0	14.0	
Woods Operations	5.3	0.7	0.5	2.0	---	1.0	---	1.0	1.7	
Railways	2.1	---	2.9	---	---	2.0	1.0	---	---	
Other Industries	1.8	1.6	2.4	4.0	4.0	3.0	4.0	1.0	1.2	
Incendiary	10.0	11.5	3.2	8.0	12.0	6.0	7.0	6.0	3.1	
Misc. Known	0.9	0.7	---	5.0	4.0	8.0	9.0	6.0	5.1	
Total Known Man-Caused	64.2	48.6	33.6	47.0	41.0	73.0	60.0	50.0	39.9	
Lightning	28.2	48.9	60.8	40.0	54.0	27.0	30.0	37.0	57.4	
Unknown	7.6	2.5	5.6	13.0	5.0	15.0	10.0	13.0	2.7	

Yukon Territory 1970-1979
Causes of Forest Fires in Percent

Year/Cause	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Recreation	10.0	8.0	10.0		10.8	29.6	16.0	34.3	44.6	
Settlement	5.0	8.0	2.0		7.2	3.6	3.0	12.8	---	
Woods Operations	0.5	---	1.0		0.6	2.7	2.0	3.9	6.2	
Railways	---	---	1.0		---	---	---	---	---	
Other Industries	2.0	---	2.0		4.2	5.4	4.0	5.9	15.4	
Misc. Known	2.3	8.0	6.0		7.8	8.9	3.0	8.8	---	
Incendiary	0.5	6.0	1.0		1.8	0.9	2.0	3.9	---	
Public Works	---	---	4.0		---	---	---	---	---	
Total Known Man-Caused	41.0	30.0	37.0		32.4	51.1	30.0	69.5	66.2	
Lightning	50.0	58.0	34.0		63.4	43.8	64.0	26.5	32.3	
Unknown	9.0	12.0	29.0		4.2	5.4	6.0	2.9	1.5	

Appendix VIII Fire - Weather Pattern - Summer of 1979

Introduction

The border area of Northwest Territories, Saskatchewan and Alberta (near Fort Smith) was the scene of a 1 1/4 million acre burn in July of 1979, most of it in the Northwest Territories. Several weather factors responsible for such a massive burn coincided during the summer of 1979. Although exceptional, such a critical combination of weather factors is hardly unique and can be expected to re-appear within a decade or two.

Simply expressed, the massive burn was caused by the coincidence of the five following major fuel and meteorological factors.

Factor 1

Large tracts of slow-growth coniferous fuel (such stands are susceptible to summer fires as they exhibit a weak green-up component).

Factor 2

A dry period preceding the fire outbreak.

Factor 3

Dry lightning ignition from high-based thunderstorm cells.

Factor 4

High sustained winds immediately after ignition spreading the fires totally out of control.

Factor 5

A persistent drought preventing relief from significant helpful rain and extending the fire duration.

The Dominant Pattern

Figures 1, 2, 3 and 4 depict the monthly and cumulative seasonal precipitation expressed as a percentage of normal.

The Fort Smith sector experienced prolonged dryness (drought) in May and June prior to fire ignition. Figure 4 depicts the severe seasonal drought pattern as the May to September precipitation was only 40% of normal.

Figure 5 shows the upper air circulation features at about 5700 m above sea-level (500 millibars) prevailing from June 29 - July 6, 1979 — a critical period in the history of the forest fire outbreak and spread. It depicts the classical blocking weather pattern with an intense high pressure ridge flanked by two cut-off low pressure areas. Such a pattern is dynamically stable and stays "locked" into position for a prolonged duration.

Figure 6 shows the surface weather pattern prevailing from June 29 - July 6, 1979. The Hudson's Bay surface high blocked the progress of the first upper frontal system which frequently triggered high-based, dry, convective lightning storm cells along the Alberta, Saskatchewan, Northwest Territories border area. Moister, subsequent Pacific frontal systems remained blocked further west preventing helpful precipitation from spreading eastward.

The combination of a Fort Nelson surface low and Hudson's Bay surface high produced the strong, persistent, southeasterly winds that fanned the forest fires in the Fort Smith area into a massive conflagration during this critical period.

Figure 7 shows the dominance of upper air anticyclone (high pressure) centres over the Mackenzie Valley area during the month of July, 1979.

Figure 8 shows the dominance of upper air cyclone (low pressure) centres over the North Pacific with break-away centres entering mid British Columbia and west-central Alberta but then deflecting backwards into Northern British Columbia. This mechanism prevented the normal eastward progression of rain-bearing weather systems and full-scale drought was in progress over the Northwest Territories.

Another critical fire period occurred August 15-18 when south-easterly winds shifted abruptly to gusty northwesterly behind a Mackenzie Valley dry cold frontal passage.

Conclusion

The million acre plus burn of 1979 was aided and abetted by the critical combination of five major weather and fuel factors. Although such a combination is uncommon, it is not unique and future encores can be expected a decade or two down the road. Furthermore, an unusually bad fire season can be accompanied by adjacent fire seasons nearly as severe until a wetter cycle returns to the area and breaks the recurring pattern.

15 April 1980

E. Stashco

Alberta Forest Service

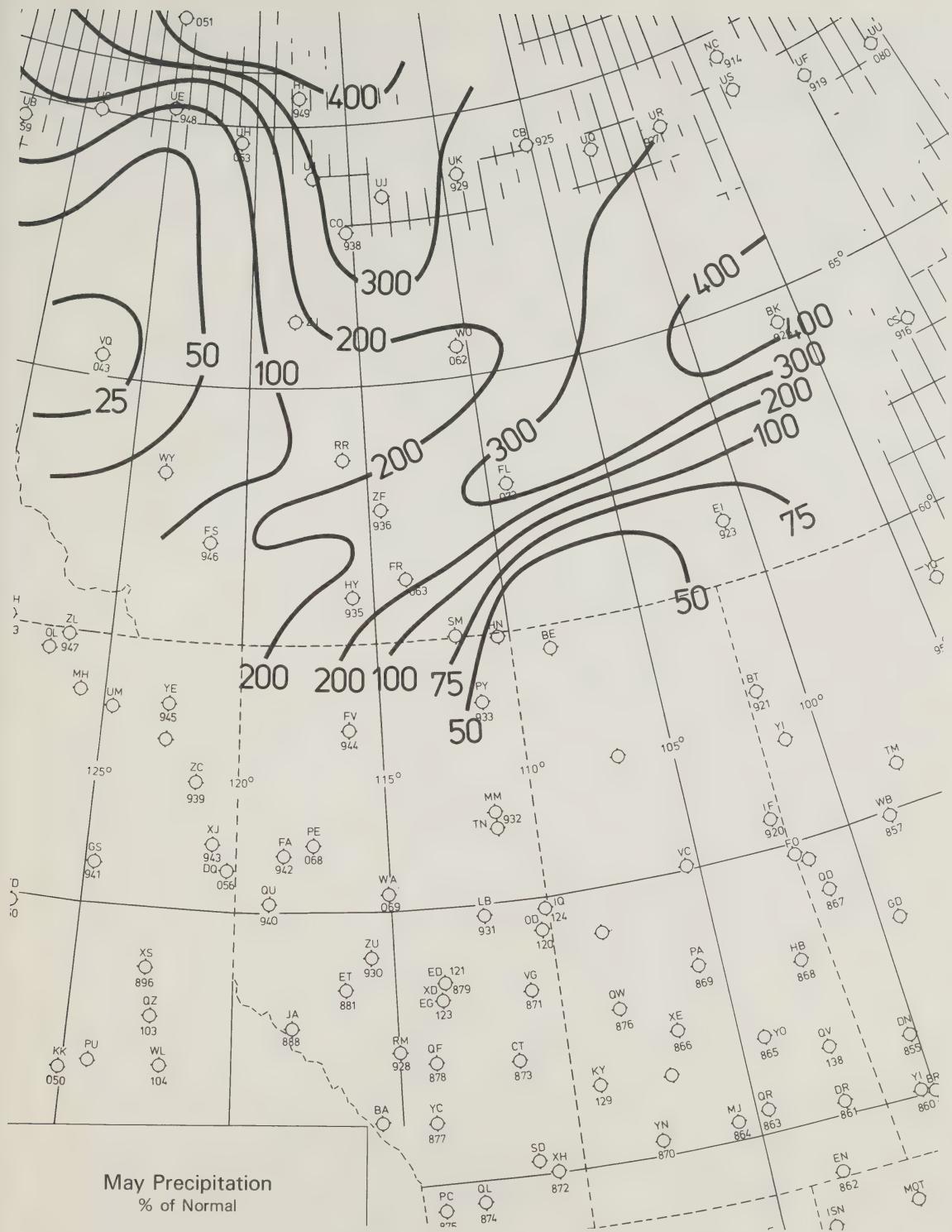


Figure 1: May Precipitation, Percentage of Normal.

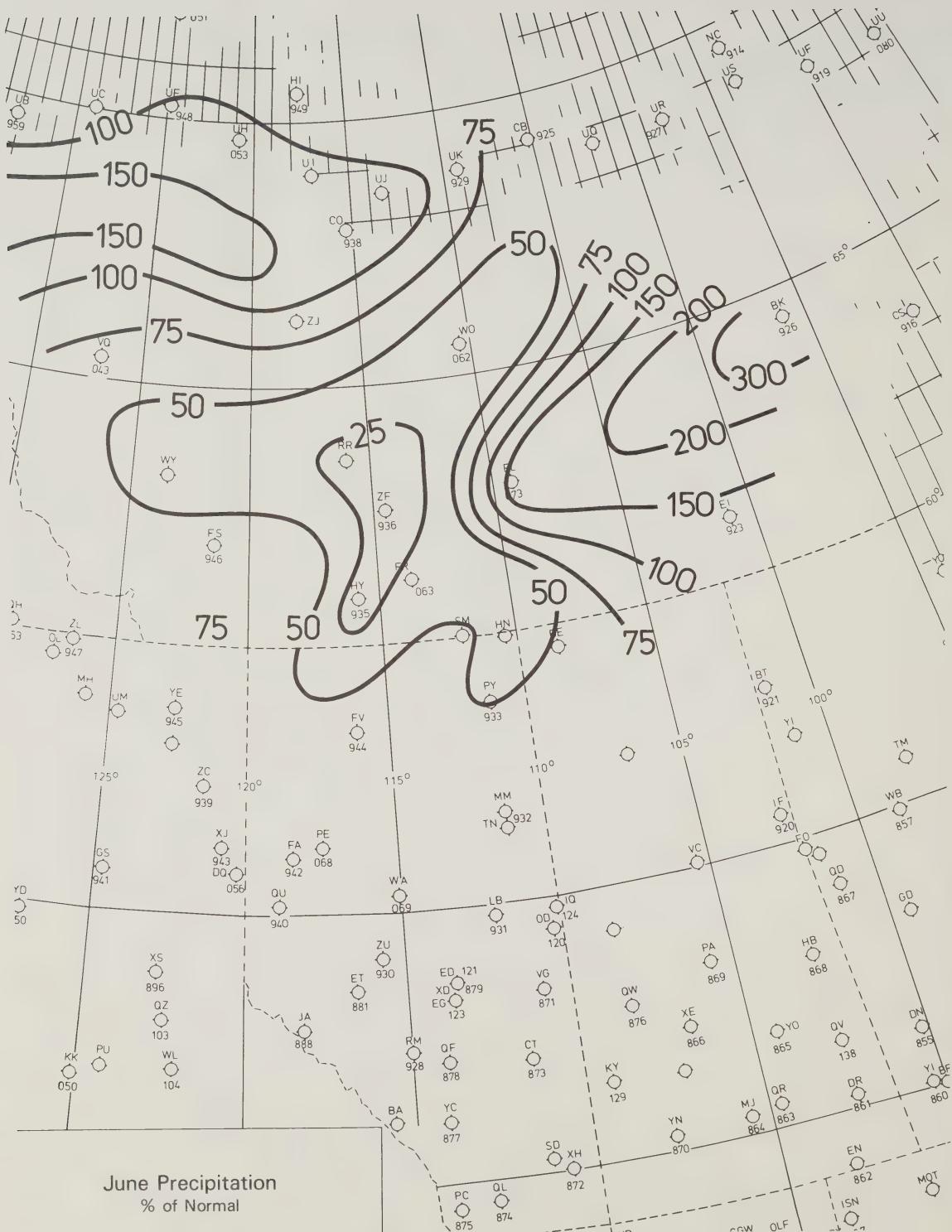


Figure 2: June Precipitation, Percentage of Normal.

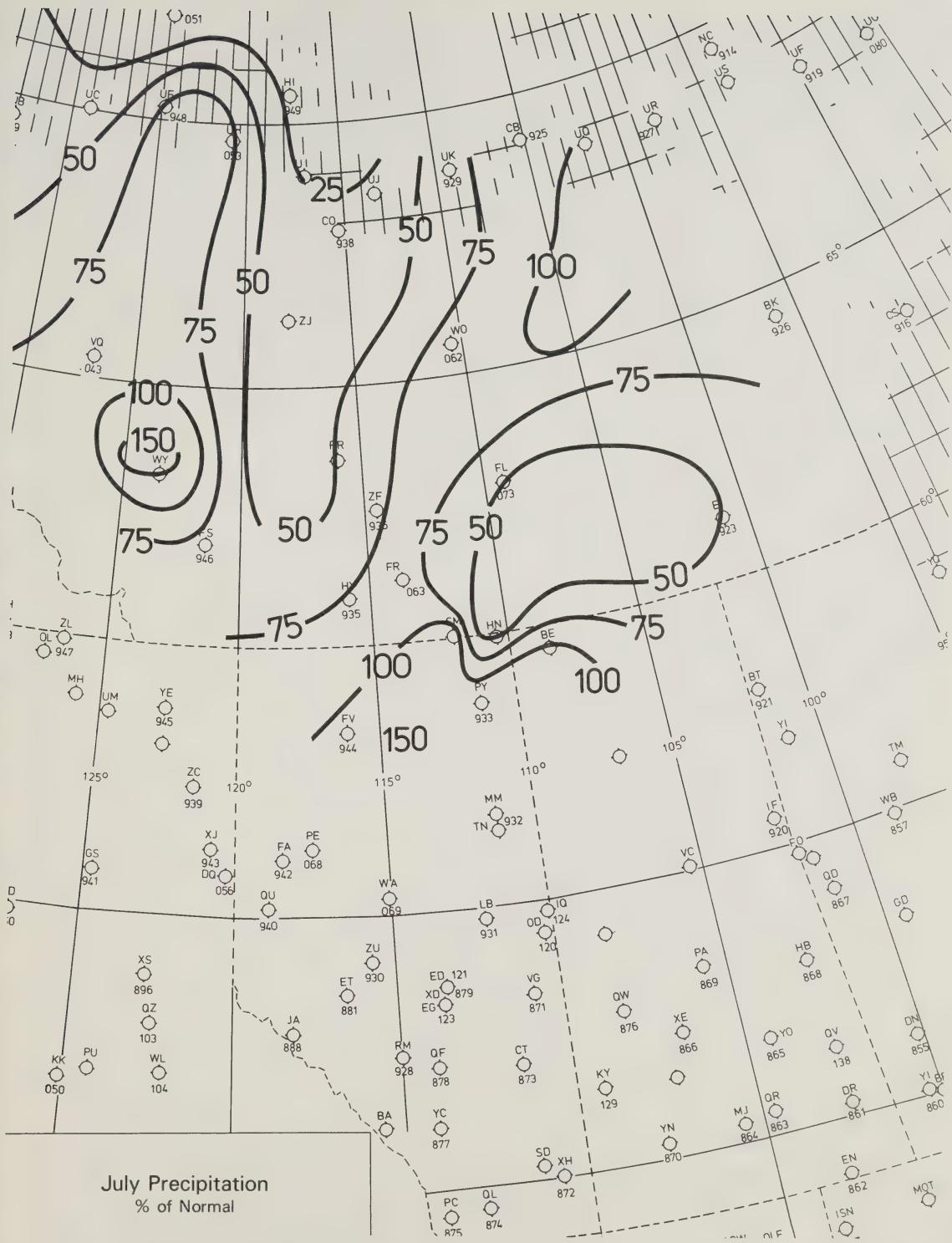
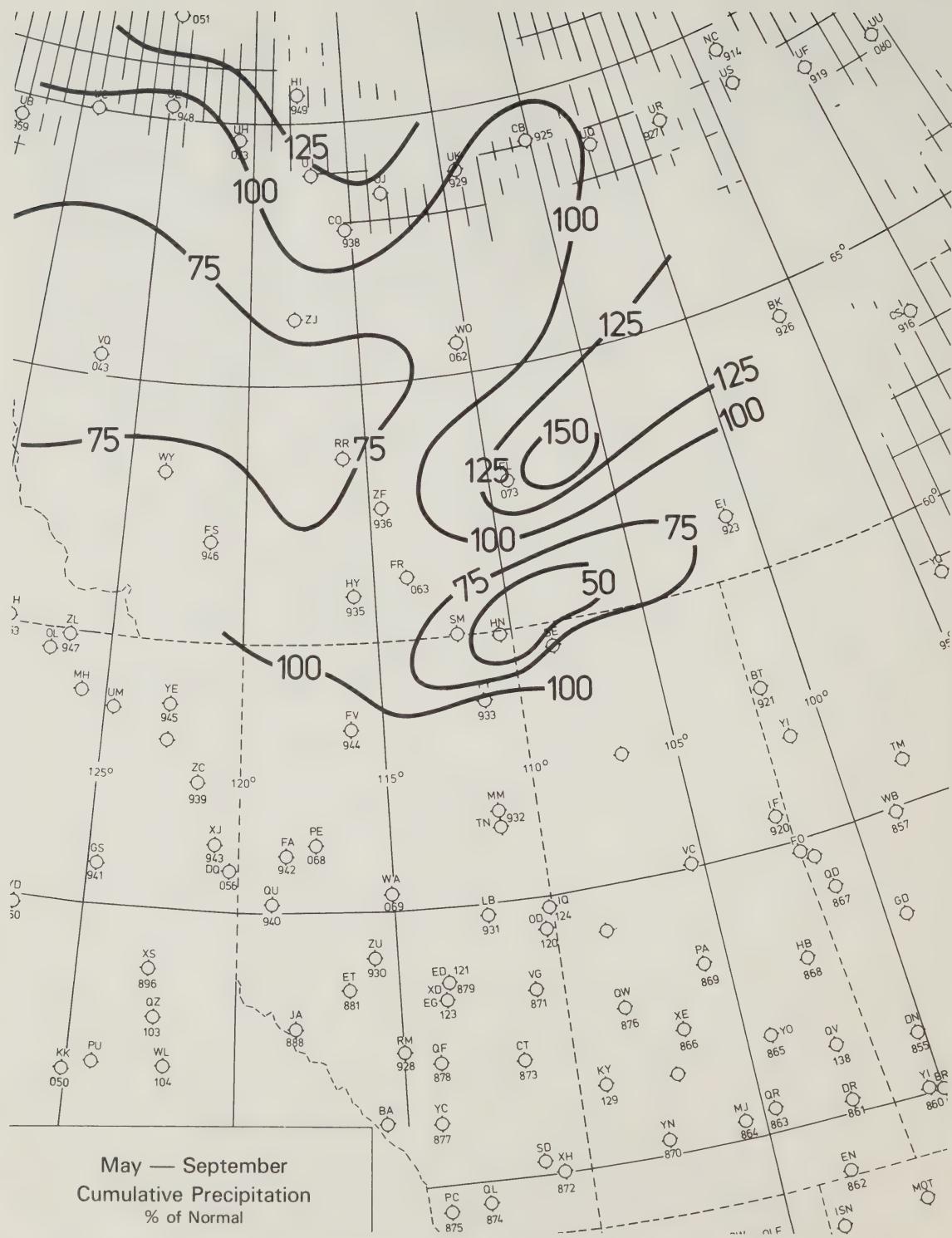


Figure 3: July Precipitation, Percentage of Normal.



May — September
Cumulative Precipitation
% of Normal

Figure 4: May to September Cumulative Precipitation, Percentage of Normal.

500MB Contour Heights in Metres Above Sea-level

July 29 — July 6, 1979

500MB Mean

Mean Upper Air Circulation Pattern

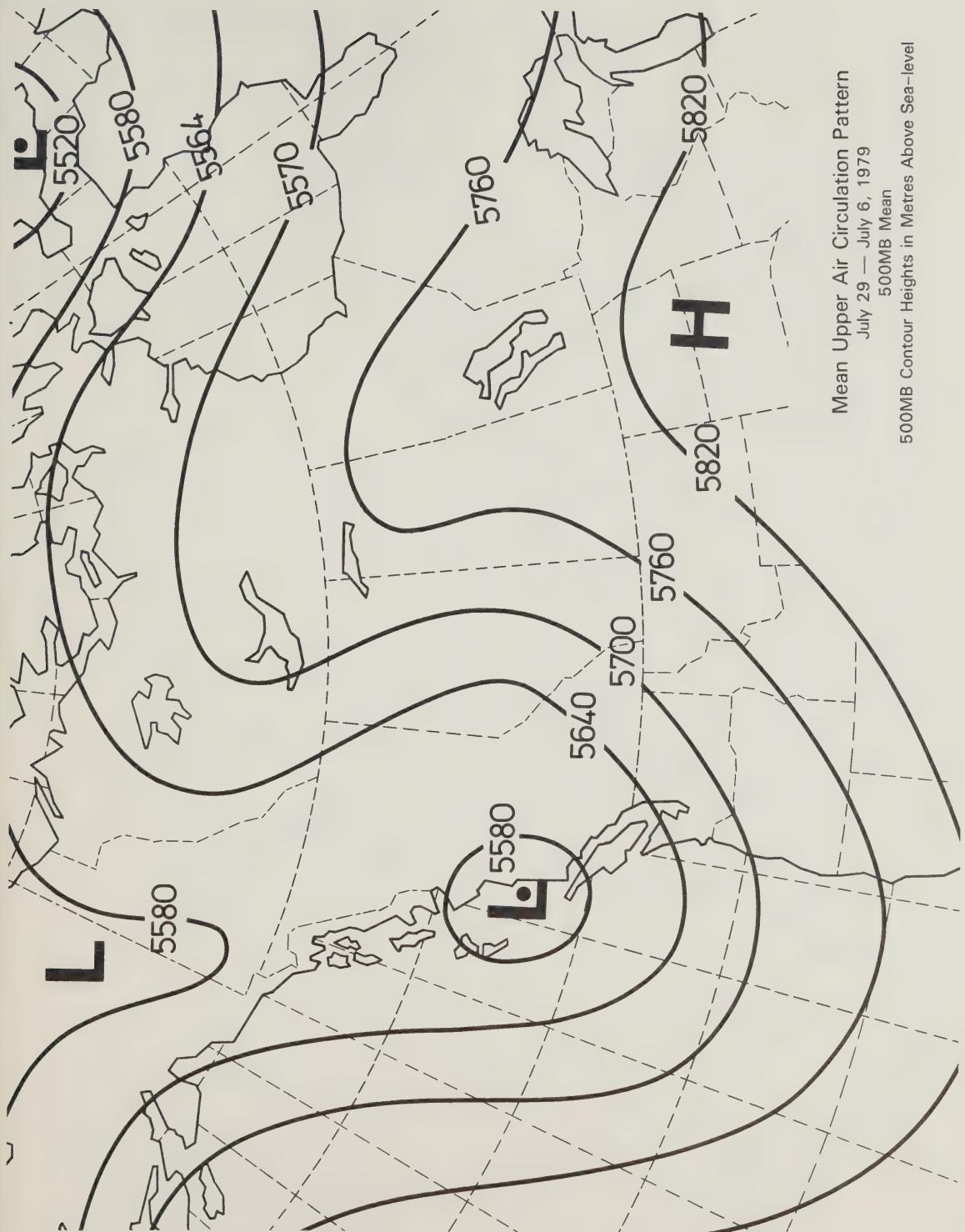


Figure 5: Mean Upper Air Circulation Pattern, June 29 to July 6, 1979.

Mean Surface Weather Pattern
June 29 — July 6, 1979
Isobars Labelled in Millibars

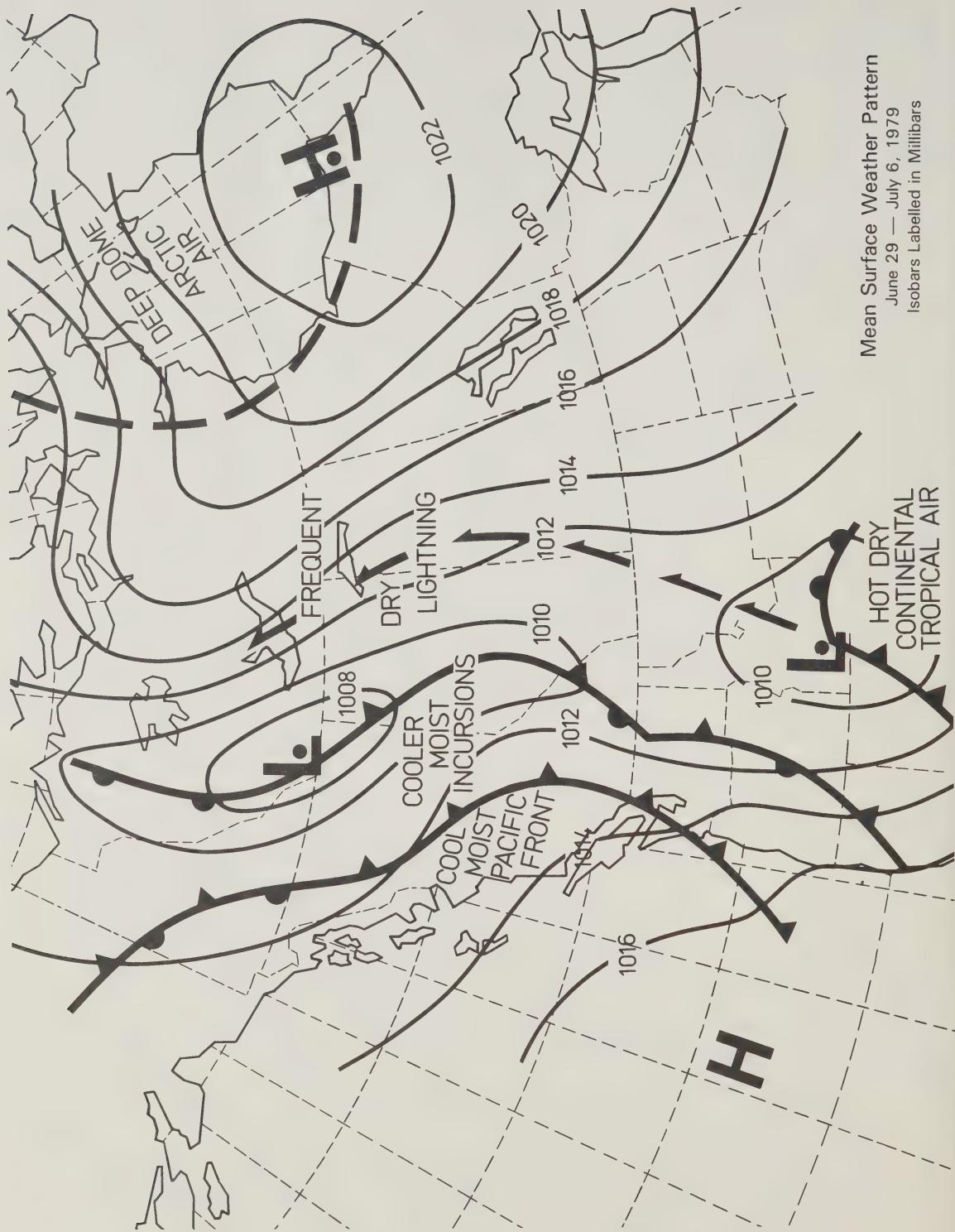


Figure 6: Mean Surface Weather Pattern, June 29 to July 6, 1979.

Frequency of Upper Air
Anticyclone Centres
700MB, July, 1979

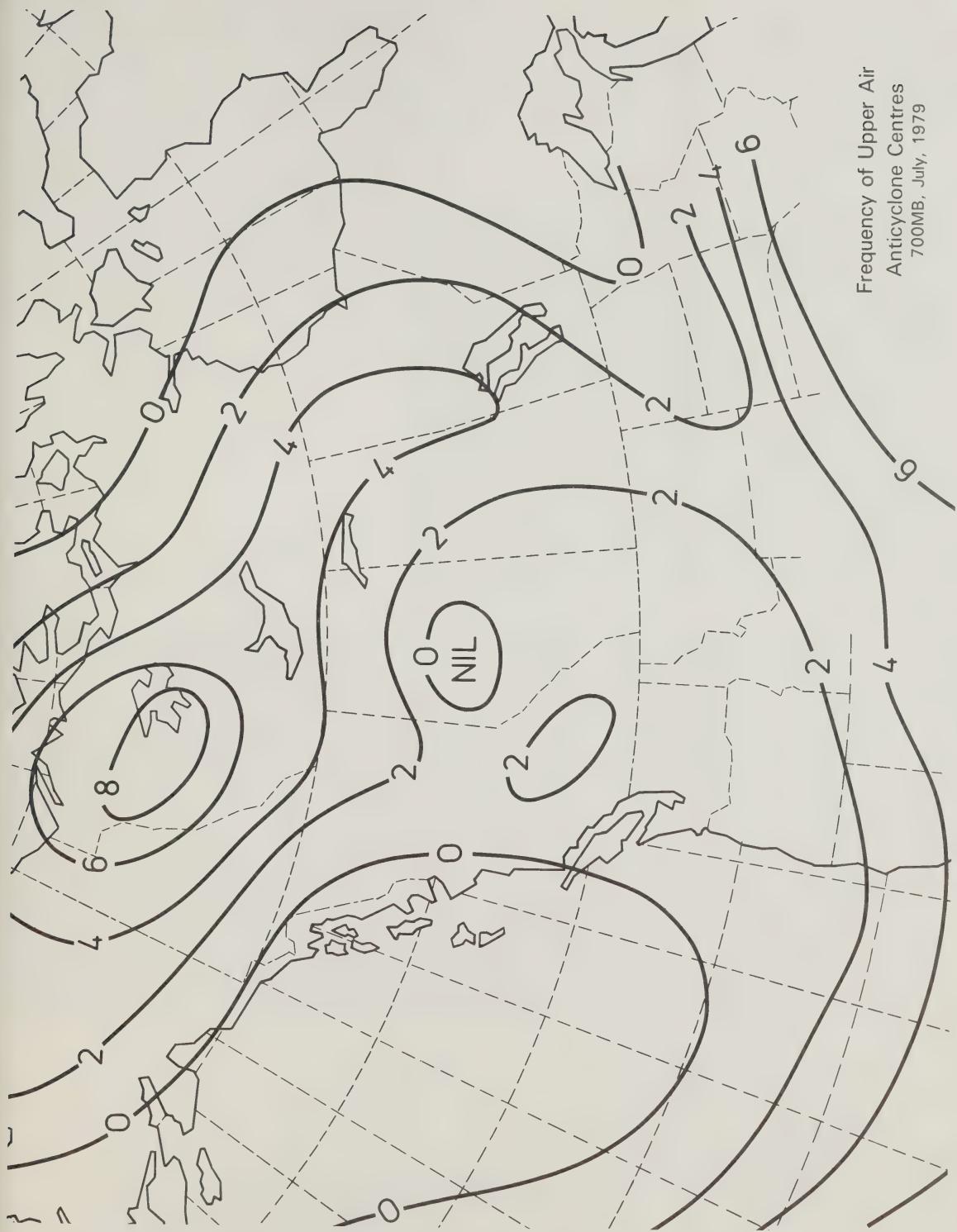


Figure 7: Frequency of Upper Air Anticyclone Centres, July 1979.

Frequency of Upper Air Cyclone Centres
700MB July, 1979

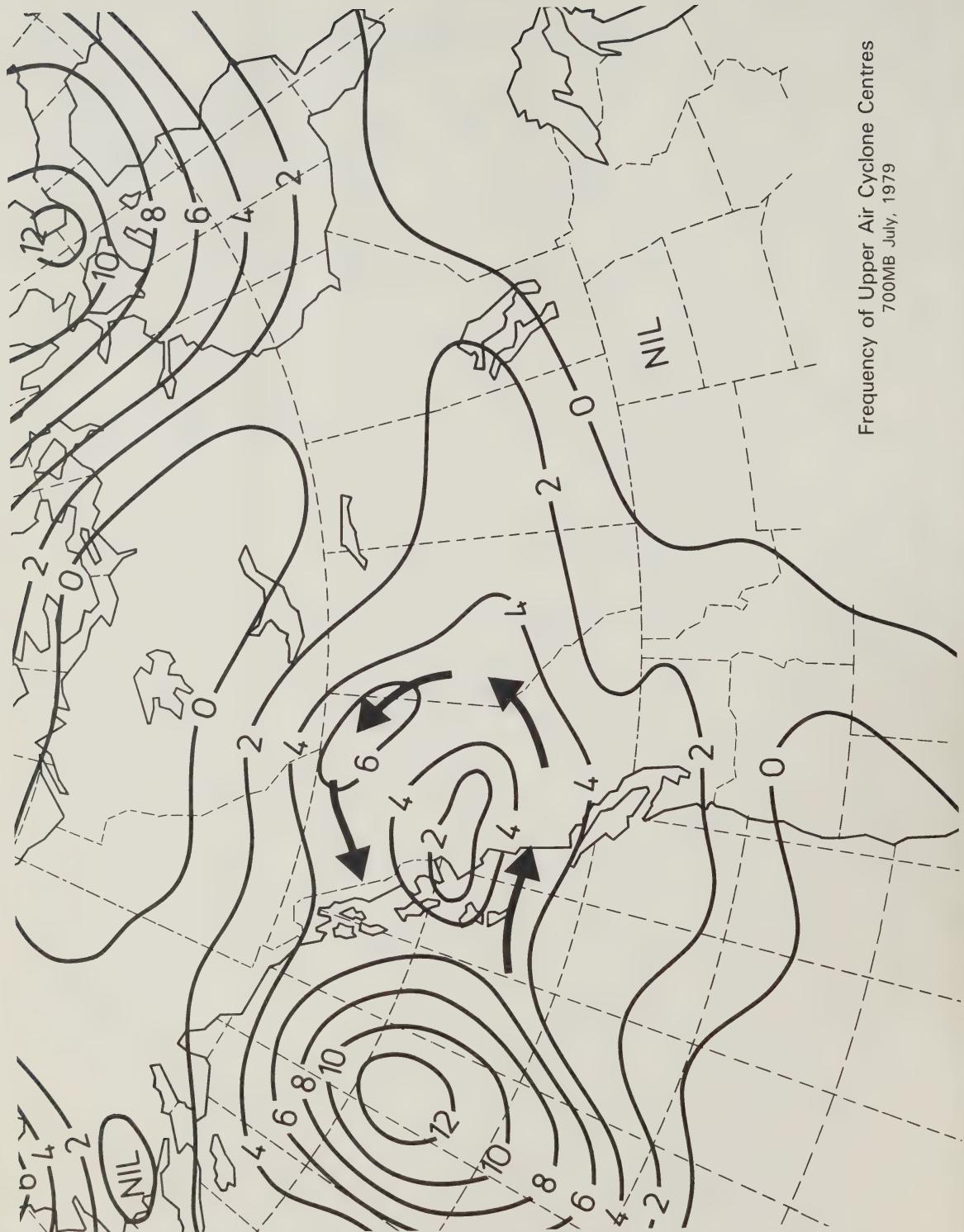


Figure 8: Frequency of Upper Air Cyclone Centres, July 1979.

Appendix IX Pictorial View

Figure 1: Typical flammable fuels — lichens, black spruce, resinous shrubs and moss.
(Lanoville)▷



Figure 2: Fire will burn through "green" areas during dry periods. Hay River fire 41, 17 August, 1979 at 2030h. (Lanoville)▽



Figure 3: Surface and ladder fuels lead to crowning. VQ fire 22, 3 August, 1979. Ten minutes after ignition of a spot fire. (Lanoville)▷



Figure 4: Crown fires burn with high intensity and 'spot' ahead, HY fire 41, 18 August, 1979. (Lanoville)▷



Figure 5: Extensive crown fires are virtually unstoppable. Pine Point fire one hour after reported. HY-41-79. (Air Attack Supervisor)▷



Figure 6: Spotting spreads fire even through wet areas. VQ-26-1977. (Lanoville)▷



Figure 7: Fires can move quickly in continuous fuels under strong winds. VQ-26-1977. (Lanoville) ▷



Figure 8: Most communities are in flammable settings — they need protection and fuels treatments. Fort Resolution 1976. (Hagen) ▷



Figure 9: Pine Point was threatened in 1979 for the second time in eight years. HY-41-1979. (Lanoville) ▷



Figure 10: The Forest Service saved the Boot family camp by backfiring from a hand-cleared line. Fort Smith fire 17, 1979, Backfire and main fire. (Lanoville) ▷



Figure 11: Boot family camp after the fire.
(Lanoville) ▷



Figure 12: Fires destroy timber. VQ-26-1977.
(Lanoville) ▷



Figure 13: Much of the Grand Detour has blown down and is very difficult to salvage. (Manecon) ▷



Figure 14: Fire does set the stage for renewal of growth, but recovery time in the Northwest Territories may be long. (Murphy) ▷



Figure 15: Intense fires or reburns in areas of thin soil over rock may further delay recovery of vegetation and consequently of furbearers and caribou. SM-20-1979. (Graham)



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